Railway Mechanical Engineer

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Eliminate Slack in Draft Gear

No one who makes a critical examination of freight cars in ordinary interchange service can fail to be impressed with the large amount of slack in the couplers and draft gear of many of the cars, even those of modern design. The trouble is not confined entirely to spring gears, as friction gears also exhibit a tendency to develop considerable lost motion. Any free travel in couplers or draft gears is a serious defect. The full normal travel of the gear provides a very short space in which to dissipate the energy stored in a heavily loaded car. If free travel exists, the distance over which the force can act is decreased still further and the action of the draft gear is lost during the most effective part of its travel. For example, if the travel of an ordinary gear is reduced one-half, the capacity is only one-fourth as great as before. Furthermore, any slack between cars adds to the severity of the run-in during brake applications and increases the shocks on the draft gear.

Slack in spring draft gear is usually caused by the springs taking a permanent set and should always be corrected by installing new springs, never by the application of filler blocks. Some friction gears may likewise develop slack by reason of permanent set in the springs but in many cases this seems to be due to an increase in the internal resistance which prevents the gear from returning to its normal position when released.

There seems to be a real need for educating car inspectors with regard to the serious effects of slack in draft gears as a majority of these men apparently think that the draft appliances cannot be defective unless they are torn entirely out of the car. Some railroad officers may contend that it would be impractical to try to eliminate slack in draft gear because it would overcrowd the repair tracks. There is no question but what the present condition is causing a great deal of repair work that could be avoided if the gears were kept in condition to function properly. The remedy may be found in more thorough inspection or in periodical overhauling of the draft gear. One or the other of these alternatives should be adopted.

Using Stokers Effectively

Since mechanical stokers for locomotives were first introduced, their construction has been given much thought and attention. The result is that the best designs of the present day not only fire locomotives entirely satisfactorily but are also remarkably free from mechanical defects. The stoker has now established a place for itself in locomotive practice, but the problems connected with its operation have not all been solved as yet. One point that has not been definitely determined is the field for the economical use of stokers. If a locomotive can burn 8,000 lb. of coal an hour effectively and the fireman supplies only 4,000 lb., the capacity is reduced and the wages per ton-mile increased. At some point, depending upon the weight of the locomotive, the class of service and similar factors, the stoker becomes economical, but just where the dividing line between hand firing and stoker firing lies no one seems to know. The relative fuel economy of hand and stoker firing is also important in this connection. A few comparisons of fuel performance under test conditions have been published but information as to the relative average economy of hand and stoker firing under normal service conditions would be far more valuable.

As a rule, stokers have been built and operated to fit existing conditions. If the best results are to be secured, these factors must be in a measure adapted to the stoker. The grate area on most locomotives is limited to the size which can be satisfactorily fired by hand. Since combustion efficiency is highest at comparatively low rates of firing, better performance could probably be obtained by making the grate area in all cases as great as the stoker could fire.

In operating a locomotive, the rate of combustion should be regulated to give the greatest overall economy, taking into consideration fuel, wages, repair costs and fixed charges. At very high rates of combustion, an increase in the supply of fuel may actually cause a decrease in the power output. This point may be reached in some cases by stoker firing. While it is apparent that the economical range is at a considerably lower rate, a study of the cost factors involved would indicate the maximum economical rate of fuel consumption. With such information available, the stoker manufacturers could insure the greatest economy of operation under full load conditions by establishing a corresponding limit for the maximum amount of coal which the stoker could supply.

Why Grind Piston Rods?

Railroad mechanical departments are well advised in requiring that all new methods and machines be thoroughly tested under actual working conditions, before installation in repair shops on an extensive scale. While an open-minded attitude should be taken on the question of trying out new methods, experience has shown that many of these fail to accomplish the results expected and a reasonable degree of caution in adopting them is justified. They should, however, be adopted when test results are satisfactory. The practice of truing both new and worn piston rods by grinding, for example, has certainly passed the experimental stage and thousands of ground locomotive piston rods are now in service giving uniformly satisfactory results. It is difficult to understand what justification can be found for still adhering in certain shops to the relatively slow and inaccurate process of turning and rolling piston rods.

Notwithstanding the almost universal approval of piston rod grinding, the innate caution of railroad men regarding new devices was strongly illustrated in a large railroad shop recently where it was proposed to install a machine to grind piston rods instead of continuing the older method of turning and rolling them. Those who hesitated to install the

new machine said that it must first demonstrate its superiority in a comparative test. Accordingly, a new piston rod was turned and rolled as accurately as possible. This rod was then carefully mounted in a piston rod grinder and ground, with the abrasive wheel just lightly touching the rod. The grinding operation was then stopped and observers noted that more metal was removed at certain places on the piston rod than at others and in some places the abrasive wheel did not touch the rod at all. Micrometer calipers checked the accuracy of grinding both as regards taper and roundness of the rod. The fact that more metal was removed by grinding at certain places than at others proved conclusively that the rod, as rolled previous to grinding, was not a true cylinder. This was evidently due to the fact that the rod was non-homogeneous, being softer in some spots than in others with the result that the roll depressed these soft spots unduly. The grinding machine, on the other hand, exerted hardly any pressure on the rod and removed as much metal from the soft spots as the hard, producing a true cylindrical surface.

In the days of wick packing the accuracy of piston rods did not make so much difference, but now that metallic packing is used almost universally, it is evident that this packing cannot hold steam and last for any considerable length of time unless piston rods are accurately round, smooth and, practically speaking, without taper. That these qualifications are best obtained by the use of modern piston rod grinding machines is evident from the many ground piston rods now in daily use and giving satisfactory service.

Mechanical Design of Locomotives

Before the advent of the heavy modern locomotive, the mechanical features of the locomotive design did not demand very careful attention. In most cases the parts were light, clearance was not a limiting factor and stresses and pressures were well within the allowable limits for ordinary material. In the locomotive of today, conditions are entirely different. So many restrictions hamper the designer that it is often impossible to keep within the limits of good practice. As a result, the maintenance of machinery is becoming more and more troublesome. It is interesting to compare the designs of early locomotives with those of the present day. Such a comparison soon makes it evident that many locomotive parts as commonly constructed are merely overgrown specimens of designs that were in use when the prevailing type for passenger and freight service was the eight-wheel locomotive. Many of these designs have the merits of being simple and easily made, but has not too high a value been placed on simplicity and low cost in the design of motive power? There are opportunities for refinements that save weight, reduce the cost of upkeep and increase the proportion of time the locomotive spends on the road. There is a field for improved material that will give longer service between repairs. Such refinements can more than pay their cost, especially under present labor conditions.

It is natural to ask where refinements in the design of machinery should begin. The logical method would be to start with those parts which cause the heaviest expense for repairs and time out of service. Driving boxes should be redesigned to provide bearings that will withstand the thrust of the piston without excessive wear or to permit replacements to be made without dropping the wheels. Tire wear is another source of heavy expense. Locomotives with long rigid wheelbases should be especially designed to avoid excessive flange pressure and thus prevent the development of sharp flanges. Counterbalancing likewise is a serious problem, which involves especially improvements in rods, crossheads and pistons. Main rod bearings are now such a serious factor in roundhouse maintenance that their design should be given careful thought. High steam temperatures tend to shorten the life of piston rings and the cost of replacement is high; therefore both type of ring and the material need to be selected with a view to getting the maximum service.

These are a few of the more important points where service, rather than precedent or first cost, should cover design. Simple, straightforward construction will not give results on modern locomotives and today further refinements are essential. In the past simplicity has been almost an end in itself, but it is well to bear in mind that refined designs are not necessarily complicated designs, and that complicated designs are not necessarily expensive to maintain.

Air Pressure and Car Repairs

It is estimated on the best authority that there are over 700 car repair shops and almost 1,900 cripple tracks in the United States devoted to the repair of both wooden and steel cars. According to the latest statistics published by the Interstate Commerce Commission, railroad operating companies in the United States own over 2,600,000 cars, including freight cars, passenger cars and company cars. A large proportion of this equipment is in service and the task of maintaining it in good running order is not always appreciated. It is of great magnitude, employing the services of many thousands of men.

One of the things which make modern car repair work far easier than it was in earlier days is the use of pneumatic tools of all kinds, including presses, jacks, drills, rivet-shearing, punching and heading tools and many other pneumatic tools too numerous to mention. These save an immense amount of manual labor and are most effective in speeding up car repair work and reducing the unit cost of repairs. Because of the increasing number of pneumatic tools used, however, many air compressors now installed are proving of insufficient capacity. Either the shops have been enlarged since the compressor was installed or additional cripple tracks have been provided. The result is that the air compressor is too small to carry the load, or, in some instances, the initial pipe line is too small to carry an adequate amount of air and at the same time maintain the necessary high pressure at the end of the line.

It is important that pneumatic tools be operated as efficiently from the end of the line as anywhere else and the costliness of allowing insufficient compressor capacity or small pipe lines to reduce the air pressure has been demonstrated by experience and many tests. In a recent specific case an air hammer was tested cutting off rivets. When operating under the usual air pressure delivered by the compressor (80 lb. per sq. in.), the air hammer cut off rivets with approximately seven blows a piece. With the air pressure reduced to 50 lb., owing to excessive use of air at another point on the line, it took about 50 blows to sever each rivet head. This meant that there was an enormous waste of air and also of the operator's time. No argument is necessary to support the contention that adequate air compressor capacity and pipe lines of ample size should be provided if satisfactory results are to be obtained.

Another factor making it difficult to maintain air pressure is the leakage of air along the line; this in addition to reducing the air pressure and consequently the efficiency of pneumatic tools, represent a direct money loss through the coal pile. At plants of any appreciable size it has been found profitable to assign one man to continually inspect air lines, valves and fittings, making what repairs may be necessary to eliminate air losses at these points. The provision of an adequate supply of air and its efficient use in car repair work are highly important owing to the possibility of speeding up the work and saving coal which is lost whenever air is wasted.

Do You Read This Page?

WE have been trying to get into more intimate touch with the individual readers of the *Railway Mechanical Engineer:* First, because it is your paper and will succeed only insofar as it proves of practical value and service to you. Second, its subscribers form a great club made up of the best minds in the railway mechanical departments; in the interests of the club as a whole, all of its members should co-operate in helping to make the *Railway Mechanical Engineer* a clearing house for the best ideas, methods, practices, etc., in the field.

We want you to feel a very direct responsibility in this respect. Write and tell us of the good things that you have observed, or are doing, or of ideas that you think will bear fruit if tested out. Or tell us of your problems and how we can help you. Or give us the benefit of your criticism if you do not agree with editorial comments or other articles. Remember, also, that the latch string always hangs out at our various editorial offices.

This month, with the conventions at Atlantic City, will be a busy one for us. Many of you will attend these meetings. We shall be glad to have you drop in at our offices, just inside the main entrance to Young's Million Dollar Pier, and get personally acquainted with the members of our staff.

Incidentally, this big June number—our annual Shop Equipment Number—will be followed by the eight issues of the *Daily Railway Age.* These will contain complete reports of the meetings of Division V—Mechanical, and Division VI—Purchases and Stores, American Railway Association; also of the Air Brake Association and the Association of Railway Electrical Engineers which also meet in Atlantic City.

It was necessary to close this number a little earlier than usual because of its large size, and reports of the meetings of the Master Boiler Makers' Association and the International Railway Fuel Association, both of which were held at Chicago late in the month of May, will be published in our July number.

Don't forget that we cordially solicit your individual help and co-operation in our efforts to make the *Railway Mechanical Engineer* a better and more effective paper.

Sincerely,

Roy V. Wright

NEW BOOKS

DESIGN OF STEEL MILL BUILDINGS. *By Milo S. Ketchum, director of the department and professor of civil engineering, University of Pennsylvania. 6½ in. by 9 in., 632 pages, 410 illustrations. Published by the McGraw-Hill Book Company, New York.*

This is the fourth edition of this book on the design of steel mill buildings; it has been rewritten and enlarged. In the original edition, it was intended to provide a short course in the calculation of stresses in framed structures and to give a brief discussion of mill building construction, with the underlying idea of presenting methods, data, and details on design and the making of estimates not ordinarily found available. The fourth edition, following along these lines, has been enlarged to include a discussion of the calculation of the stresses is statically indeterminate trusses and frames, several problems in framed structures, detailed designs of a crane girder, a roof truss and a steel frame mill building. The text has been divided into three parts and an appendix, the latter covering specifications for steel frame buildings.

THE ENGINEERING INDEX, 1921. *584 pages, 7 in. by 9½ in., bound in cloth. Published by The American Society of Mechanical Engineers, 29 West Thirty-ninth Street, New York.*

The Engineering Index has for years been considered an absolutely essential reference book by those who wish to keep in touch with current engineering literature and is always a welcome addition to an engineering library. Even those who have occasion to consult it only occasionally, appreciate its value and completeness when they find it necessary to investigate any of the numerous subjects covered.

The first volume of the Index appeared in 1892 and since 1906 has been issued annually. Up to 1918 it was prepared and published by the Engineering Magazine Company and since by the American Society of Mechanical Engineers. The current volume contains over 14,000 items referring to articles which appeared in some 600 engineering and other technical publications. In the preparation of the index the staff of the Society reviewed more than 1,200 periodicals, reports and other publications regularly received during the year by the Engineering Societies' Library, New York. These publications were printed in ten different languages and, as a result, the book is the most complete reference to scientific and engineering current literature in the world. The railway field is, if anything, even more completely covered than in former editions. This department includes rolling stock, terminals, shops, signaling, track and yards, together with all phases of construction, maintenance and operation.

MECHANICAL APPLIANCES FOR HANDLING RAILWAY TRAFFIC. *By George Bulkeley. 132 pages, 5 in. by 7½ in., illustrated, bound in cloth. Published by the Railway Gazette, London, England.*

As the importance, and in many cases the absolute necessity, of material handling devices is being more clearly recognized every day, any book as suggestive as this will be of interest to many. While the author, who is connected with the Great Western Railway, has evidently had in mind primarily the needs of freight houses, transfer points, terminals and docks, many of the devices and methods shown are also of use at storehouses, shops, roundhouses and other places.

Of the 94 illustrations, the majority show different types of material handling machinery in actual service moving various materials under diverse conditions. In addition to these application photographs there are several diagrams showing principles involved also methods and arrangements that have been found to be successful.

Such commonly employed devices as wedges, jacks, chain and rope blocks, hand cranes, winches, ropes, hooks and derricks are treated first. Following this is a chapter on portable devices, including hand trucks, industrial power trucks, tractors, trailers, portable cranes, stackers and various types of portable conveyors. The next chapter treats of cranes, continuous conveyors and various combined appliances. Electric telphers and overhead carrier systems are described and shown in use. Chapters on highway cartage, dock working and the equipment for medium sized freight stations and storehouses complete the book.

OPERATING ENGINEER'S CATECHISM OF STEAM ENGINEERING. *By Michael H. Gornston. 428 pages, 4½ in. by 7½ in., bound in leather. Published by D. Van Nostrand Company, New York.*

This book is of special interest and service to younger operating engineers and students. It contains 1,300 questions and answers which, as a rule, are clearly and concisely stated. Its form will appeal particularly to those who are not accustomed to concentrated study and is, for this reason, rather elementary in its treatment of the different subjects. The author is a steam engineer in the department of education of the City of New York and in writing the book evidently had in mind the engineer who wished to prepare himself for such examinations as are required for civil service positions, municipal or state. The book, however, will also be of use in the library of older and more experienced engineers, for reference purposes. Among the subjects discussed are heat, steam, combustion, boilers, engines and condensers, together with chapters on the practical management of boilers, engines and auxiliary machinery. Pumping machinery, steam heating, stokers and also pulleys and belting are included. The book is well printed and of convenient size although it would have been improved by the use of more illustrations. An excellent index of 32 pages adds considerably to its value.

FUEL AND REFRACTORY MATERIALS. *By A. Humboldt Sexton and W. B. Davidson. 382 pages, illustrated, 6 in. by 9 in., bound in cloth. Published by D. Van Nostrand Company, New York.*

This book is a revised edition of the well-known work by Professor Sexton, who was at one time president of the West of Scotland Iron & Steel Institute. The present edition has been practically rewritten and its scope enlarged by W. B. Davidson. Its real value is as a reference book and as such will be found valuable by those who wish to consult from time to time an authoritative work on the subject of fuels.

The different points taken up are treated in the thorough manner which is often characteristic of British writers, and although a greater attention to American fuels and practices would be desirable, the viewpoint is general and largely world-wide. The opening chapter takes up the theory of combustion. This is followed by information in regard to the heating power of fuels and the characteristics of wood, coal, peat, charcoal, coke, etc. Coal washing and the preparation of various fuels is described at length. The next two chapters treat of liquid and gaseous fuels, their characteristics, manufacture and use in various industries. The next subject discussed is that of by-products and low temperature carbonization. Considerable practical information is contained in the chapters on furnaces for various purposes, supply of air and smoke prevention. Pyrometry, calorimetry, utilization of fuel and the testing of fuels are covered in a complete and interesting manner.

The title of the book is slightly misleading as only 36 pages are devoted to matters in connection with refractory materials, such as bricks, and crucibles. A few tables and a very satisfactory index complete the book.

THE CONSUMPTION OF FUEL OIL in 1921 by locomotives of the railroads in the United States amounted to 38,824,000 barrels as compared with 45,847,000 barrels in 1920. Of the total now reported, 27,615,000 barrels were domestic oil and 11,209,000 barrels were Mexican.

Locomotives Are Washed While Taking Water

Expediting Enginehouse Work at Hoboken

Modern Machine Equipment and Efficient Labor-Saving Devices Show Good Results at D. L. & W. Enginehouse

As the eastern terminal of the Delaware, Lackawanna & Western, the engine house at Hoboken, N. J., occupies a position of prime importance. It contains 38 stalls, employs 273 men on three shifts, and under the direction of M. R. Feeley, general roundhouse foreman, despatches 127 passenger engines every 24 hours. Credit for despatching an engine is allowed only when it is held over four hours and the actual number of engines turned at Hoboken is about 165 in 24 hours. All kinds of locomotive running repairs are made at this point except dropping the wheels which cannot be done because the enginehouse itself is on made land and the drop pit below water level at high tide. Approximately 98 boilers are washed each month.

Modern Machine Tools Installed

In view of the heavy load carried by the principal back shop of the Lackawanna at Scranton, Pa., particularly in its machine department, it was decided about a year ago to make the enginehouse at Hoboken self-supporting as regards machine work. Sufficient reserve machine shop capacity was also to be provided to take care of the needs of the enginehouses at Jersey City, Secaucus and Port Morris, N. J. In accordance with this plan, four new production machines were installed at Hoboken, including a Bullard 36-in. vertical turret lathe, a Ryerson-Conradson 18-in. by 8-ft. heavy duty engine lathe, a Coulter 26-in. openside planer and a Fox monitor brass lathe. The extent to which work on these machines has been developed is highly interesting and shows that the best of modern machines are not too good for enginehouse work.

The argument is sometimes advanced that high production machines cannot be utilized to the fullest advantage in enginehouses owing to the lack of demand for a sufficient number of similar parts to keep the machine busy. In this particular case, however, the new machines do the machine work for four enginehouses and are kept in continuous operation eight hours a day and sometimes longer manufacturing new locomotive parts and trueing or resurfacing those which are worn. With ample power, good light, plenty of work to do and efficient operators, the new machines are just as productive as if they were in a back shop.

Their work is both rapid and accurate, two qualifications often more essential in roundhouses than in back shops. When a back-end brass is sent in from an outside point to be reduced and rebored, for example, the engine is usually wanted in a hurry. The sooner the brass can be machined the better and it is essential that the brass be bored accurately as to size and square with the strap and main rod. Otherwise when returned to the locomotive it will not fit, resulting in still further locomotive delay. It is an obvious and far too common mistake to assume that any old worn-out machine tool is good enough for use in an enginehouse.

The vertical turret lathe, a close-up view of which is shown in Fig. 1, is used for manufacturing cylinder packing, valve rings, bull rings, cylinder heads, piston heads, rod bushings, back end main rod brasses and other parts. The method of manufacturing cylinder packing is similar to that followed in up-to-date back shops, the packing pot being bored and turned simultaneously. The packing pot illustrated, is about as large as the machine will take, making up into thirty 27-in. rings, ⅜ in. wide and ¾ in. thick. (It is Lackawanna practice to use three relatively narrow rings in each piston.) Roughing and finishing feeds of about 1/16 in. and ¼ in. respectively are used, the cutting speed being 52 ft. per min. in each case.

The parting tool, shown in Fig. 1, cuts off five ⅜-in. rings at a time, each individual parting tool being set a little in advance of the lower one and cutting a groove 3/16 in. wide. Experience has shown that any attempt to use parting tools less than 3/16 in. wide causes more lost time in sharpening and resetting tools than is gained by additional rings obtained. A slow cross feed is used in cutting off rings in order that the sides of the rings may be finished smoothly and require no further machining. Including the

time for setting up, boring, turning, parting and a fair allowance for keeping cutting tools in good condition, it takes seven hours on an average to work up a single packing pot into thirty 27-in. rings. The work of lifting heavy pistons, packing pots, etc., from the floor to the machines and down again is greatly facilitated by a small pneumatic hoist, the handles of which may be seen above the operator's head in Fig. 1.

In accordance with what is now quite generally recognized as the best practice, piston valve chamber rings have been standardized, the new bushing and ring sizes on Lackawanna locomotives being 8, 9, 10, 12 and 14 in. respectively. These bushings are allowed ⅜ in. wear before replacement and packing rings, made 14⅜ in. in diameter, for example, will always be large enough for any 14-in. valve chamber. This enables all 14-in. packing ring dimensions to be standardized, except the outside diameter which is made 14⅜ in. to be later turned down as required by means of a special jig in an engine lathe. Moreover, 14-in. rings are standardized in sixteenths from 14 in. to 14⅜ in. This makas possible the reclamation of worn rings by turning down to the next smallest sixteenth until the 14-in. size is reached. Standardization enables valve chamber rings to be made up in quantities in advance with two important advantages. They are always on hand in case of emergency and the cost per ring of making them in quantities is less than when made singly.

Fig. 1—Manufacturing Cylinder Packing On a Vertical Turret Lathe

The time required to manufacture piston valve chamber rings was determined by a test made last February, the rings being T-rings 14⅜ in. in diameter by 1 in. wide on the face. The original diameter of the packing pot was 15 in. outside and 12 in. inside and four rings were obtained from each pot. The cutting speed at the tool point was 52 ft. per min., the roughing and finishing feeds being .063 in. and .245 in. per revolution. The time for manufacturing the four rings complete, including the time of set-up, was 75 min. It was explained that while this time could undoubtedly have been reduced by speeding up the machine and using a little coarser feed on the roughing cut, more time would probably have been lost in grinding tools.

Twenty-seven inch piston heads are turned and the rod fit bored in approximately 2½ hr. on the vertical turret lathe, removing about ⅜ in. of stock and using roughing and finishing speeds as before mentioned. A gang tool cuts the three piston grooves at one time. Approximately 20 min. is required to machine a 9-in. side rod bushing all over. In connection with reboring worn main rod back end brasses and making the bores square with the straps, a pair of parallels have been developed as shown in Fig. 2. The construction of these parallels is evident from the illustration and they are a great aid in lining up the brasses preliminary to boring. In fact, they practically prevent all chance of boring the brasses out of square.

As with the other new tools the modern 18-in. engine lathe, illustrated in Fig. 3, is held in high esteem at the Hoboken enginehouse for the reason that it is powerful, accurate and easily controlled by levers and hand-wheels within convenient reach of the operator. This lathe, with a hollow spindle enabling bar stock up to 3 in. in diameter to be passed through and held in the chuck, is used for making motion work pins and bushings, rod bushings (when the boring mill is busy), wrist pins, and miscellaneous pins, guide blocks, etc. A wide range of work is handled, sufficient to keep the lathe busy practically eight hours a day.

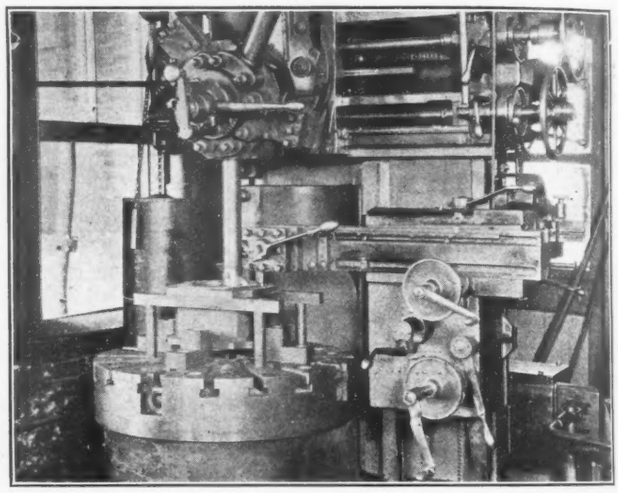


Fig. 2—Parallels Aid in Setting Up Back End Brass

Second-hand engine truck axles are annealed, cut in two with the torch, and machined into wrist pins and knuckle pins, as shown in Fig. 3. The pins are standardized as much as possible in thread size and crosshead fit, being left ⅛ in. large for the running fit in the main rod front end. This enables wrist pins to be manufactured in quantity for a given type of locomotive at a considerable saving in the cost of production.

Fig. 3—Modern Engine Lathe Machining Wrist Pins

The power of the lathe is evidenced by some of the roughing cuts taken on these engine truck axles. In spite of being annealed they are more or less hard and a cut 1 1/32 in. deep, or a 2 1/16 in. reduction in diameter is made with a cutting speed of 35 ft. per min. and 1/16 in. feed. Under this comparatively heavy duty no vibration is noticed and the thrust collars do not run warm. Fig. 3 shows the axle after it has been partially worked up into four wrist pins.

The open side planer, illustrated in Fig. 4, has also secured warm supporters at Hoboken owing to its flexibility, power and ready control. The machine was originally designed for a 24-in. maximum stroke, but arrangements were made to have the stroke increased to 26 in., thus accommodating slightly longer work. The machine is used for planing shoes and wedges, trueing the seats of Economy steam chests, shaping back and main rod brasses, engine truck boxes, driving box cellars, piston rod keys, main rod keys, etc. Ample power is provided and when occasion arises a cut of 1 1/16 in. or more can be taken on an oversized driving box shoe, the feed being about 1/32 in. and the cutting speed 40 ft. per min.

Special features of the machine are the wide range of work which can be handled on it and the ease of changing feeds and speeds while watching the progress of the cutting tool. A good idea of the range of work handled is afforded by Fig. 4. The machine may be shaping one of the big main rod brasses, or planing the extended driving box wedge in the foreground and the next minute be called on to shape the small rod key shown in the chuck.

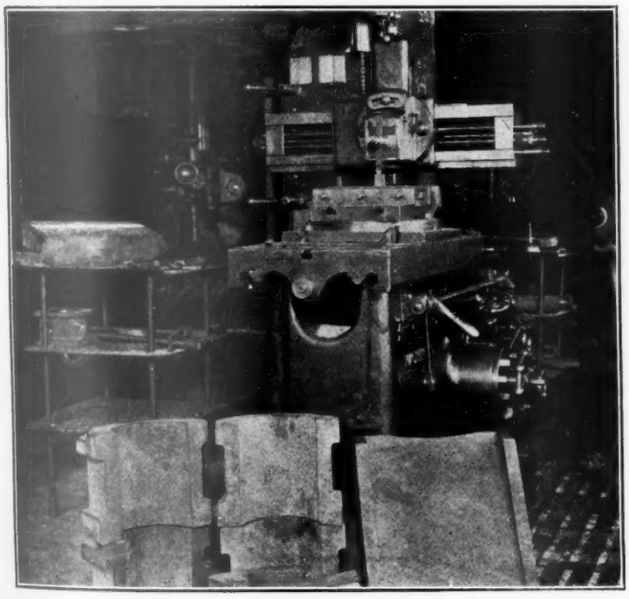


Fig. 4—The Openside Planer and Some of Its Work

A Fox monitor brass lathe, also installed with the other new machines, finds very continuous and useful service. It is used for general work in repairing and renewing parts of injectors, safety valves, boiler check valves, blow-off cocks, gage cocks, boiler fittings and other cab fittings too numerous to mention. Six turret stations are provided on this machine and the operator has developed a large number of special tools and jigs by means of which the work is greatly facilitated. Some of the jigs most commonly used, probably, are those developed for holding valve stem and piston rod packing while being bored.

General Labor-Saving Devices

A continual effort has been made at Hoboken to develop devices and methods which will save time or labor. One of the most interesting devices is a portable pneumatic oiler, credit for the development of which is due to M. R. Feeley, general foreman. Details of this oiler are shown in Fig. 5 and the method of using it in Fig. 6. It consists of a small riveted brass tank suspended from the shoulder of the oiler and arranged to fit comfortably around the left hip. The tank holds about 1½ gallons of an equal mixture of car oil and flange oil, pneumatic pressure being applied by means of a small hand pump and the oil directed where desired by a flexible tube and a bent brass nozzle. Control of the flow of oil is by a small valve under the operator's right thumb. A gage is provided to register the pressure

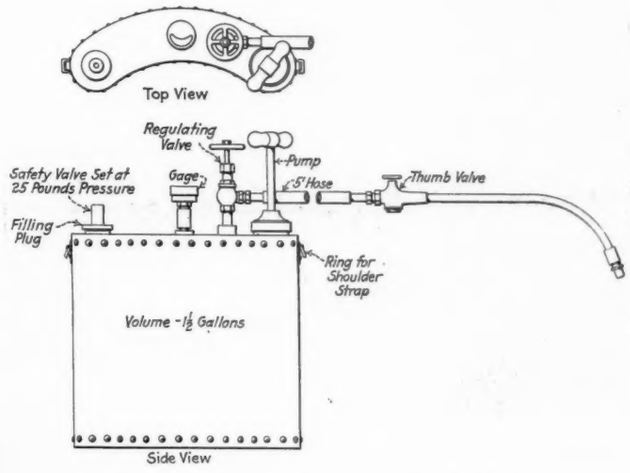


Fig. 5—Details of Pneumatic Oiling Device

and a safety valve (set at 25 lb.) also serves as the filling plug.

The particular advantages of this device consist in the ease and accuracy with which oil can be applied to driving, truck and trailer wheel hub liners, chafing plates, spring hangers which show evidence of wear, swinging cradle pins, and in fact any place where the engineman cannot get with his more or less bulky oil can. Oil can be applied just when, and where, and in the exact amount needed. It may be stated that the ease of operating this device keeps the oiler on the alert for places where a little oil will be of benefit and it is hard to estimate in actual dollars and cents the savings due to reduced wear and tear on machinery and better general lubrication.

Many places which were previously absolutely inaccessible can be readily reached with this oiling device. For example, when a crank-pin is on the top quarter it is perfectly feasible to get oil into the hub bearing. Solid engine truck wheels also make the oiling of hub bearings difficult and the way this difficulty is overcome is clearly shown in Fig. 6. Among other advantages it is estimated that at least a gallon of oil a day is saved by the pneumatic oiling device, owing to getting the oil exactly where it is needed and not wasting any.

The depressed track, illustrated in Fig. 7, while not new, is used at Hoboken for several purposes which may not be familiar to all roundhouse men. For example, it proves of great advantage in changing springs, spring hangers, spring rigging and equalizers in any part of the locomotive without the use of jacks. It is simply necessary to block the proper part of the spring rigging and run the pair of wheels into the depression. This relieves the tension on spring hanger pins and allows the required part to be taken out and repaired or renewed. Another use of the depressed track is in shimming tires. In this case a block is put between the binder and driving box and then by running the wheel in question over the depression it will be held clear

of the rail, making it easy to heat the tire and apply shims.

One of the unusual jobs possible on the depressed track is the changing of engine truck wheels without the use of jacks. By blocking under the spring rigging and tying up the engine truck it is possible to move the truck wheels over the depression, take off the pilot and front pedestals, rolling the wheels out and applying a new pair. There is no particular labor-saving by this method over the use of a drop pit but it may on occasion be extremely valuable in roundhouses having no drop pit facilities.

With a proper understanding of how to do the job an engine truck spring can be changed using the depressed track

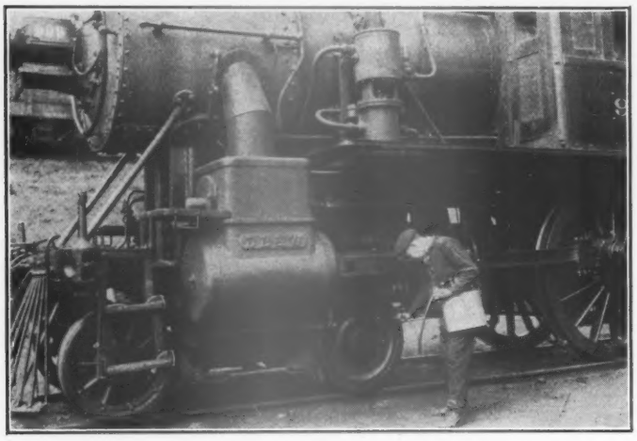


Fig. 6—Oiling a Solid Engine Truck Wheel Hub Through a Hole in the Plate

in about 15 min. The depression in the track is about 4 in. deep and 5 ft. long. Fig. 7 shows sections of rail put back in place so that an engine can ride over the depression easily. The first attempt to hold these sections of rail in place in the depressions was unsuccessful, the four guiding pieces welded on the sides of each section not being substantial enough to hold them. Experience has shown that about the best method is to provide three 1⅛ in. round plugs, spaced about 18 in. apart in each inserted rail section and engaging corresponding holes drilled in the depressed rails. It may be stated that where the lower rails are drilled to

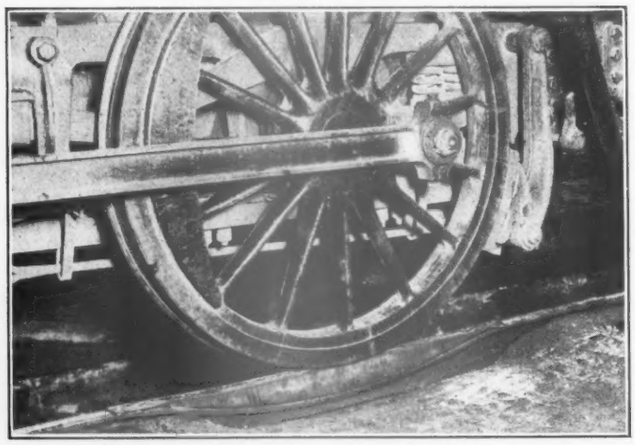


Fig. 7—Depressed Track with Rail Section Inserted

accommodate the plugs it is best to build up with electric welding around the web of the rail, thus providing additional stiffness.

The method of washing engines is of special interest due to the fact that the operation is performed while the locomotives are taking water. A mixture of hot water and oil is used, directed on the locomotive by a jet of air. With one operator working on each side no time is lost. The method is effective in keeping the locomotives clean and is relatively inexpensive, since the hot water is obtained through the boiler washing outfit from locomotives blown off on account of necessary boiler work. Arrangement is made for ample circulation of the water in cold weather and as a result

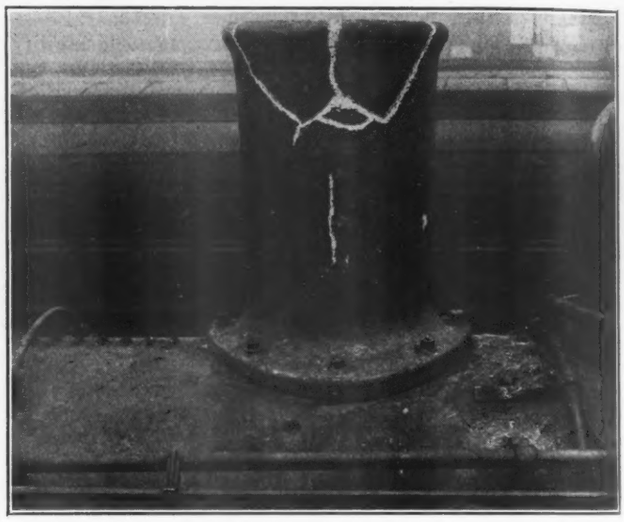


Fig. 8—Smokestack Repaired By Electric Welding

locomotives can be washed in the severe winter weather sometimes encountered in the vicinity of New York.

A great deal of effective welding work is done at the Hoboken enginehouse, including the building up of worn parts, welding broken cylinders, cracked valve ports, and in fact almost any part which fails in service. The smokestack, illustrated in Fig. 8, for example, was accidentally broken in removing a heavy steam chest with a stack crane. Three pieces of the stack fell out and were electric welded back in place as shown. (The chalked lines indicate the position of the welds.) These welds were made about six months ago and welders were getting 82 cents an hour, three hours being required for welding. The engine has since been to the back shop for heavy repairs and the inspectors evidently considered the stack good enough to go until another shopping for a new one was not applied. The preceding are but a few of many labor-saving devices and methods used at the Delaware, Lackawanna & Western enginehouse at Hoboken, N. J.

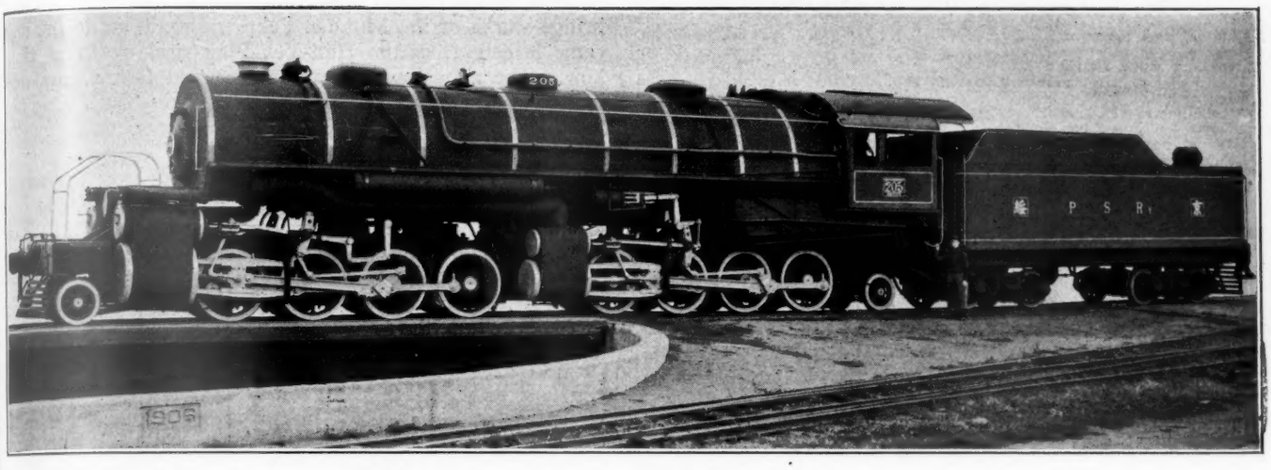
Tool Bit Cutting Tests

About 60 more tests of ¼-in. tool bits made of several grades of high speed steel when subjected to various heat treatments were recently completed by the Bureau of Standards, Department of Commerce. A preliminary summary of a portion of these tests for one steel containing .62 per cent carbon, 3.5 per cent chromium, 15.5 per cent tungsten and 1.6 per cent vanadium was made. An interesting feature is the effect of the temperature of preheating on the cutting qualities of the tools, as expressed by the pounds of metal cut. This is shown in the table below:

Preheating	Hardening	Lb. of metal cut per tool (four tools tested)
20 min. at 1,400 deg. F.	5 min. at 2,417 deg. F.—Oil	9.1
20 min. at 1,500 deg. F.	5 min. at 2,417 deg. F.—Oil	10.1
20 min. at 1,600 deg. F.	5 min. at 2,417 deg. F.—Oil	5.1
20 min. at 1,600 deg. F.	5 min. at 2,417 deg. F.—Water	5.1

Note—All testing conditions were the same.

The results obtained when using water as the quenching medium are about the same as when using oil.



The Largest Locomotive Outside of the United States Is Used on the Pekin-Suiyuan

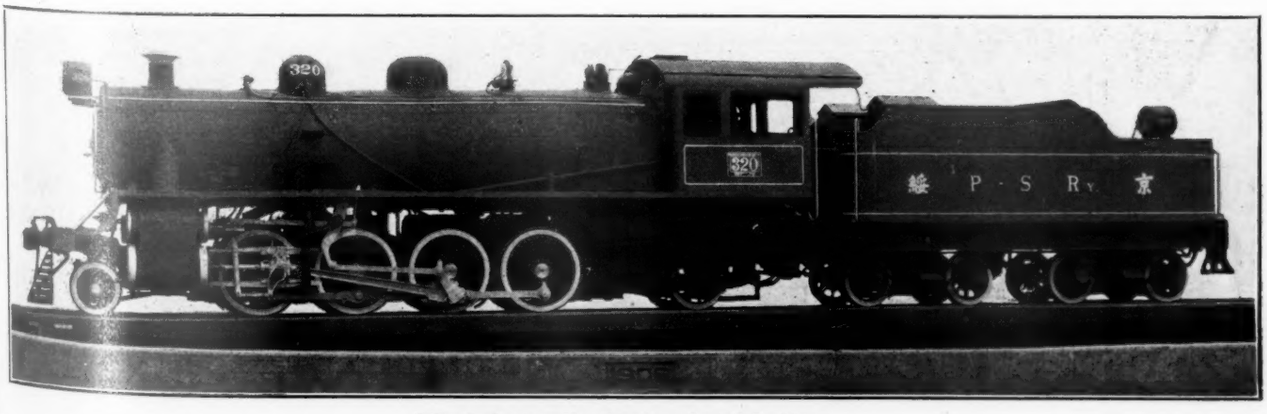
Heavy Mallet Locomotive for Pekin-Suiyuan

Largest Locomotives Exported or Operated Outside of the United States Now in Service in China

IT is somewhat startling to find that the largest locomotives that have ever been exported from this country and the most powerful in operation outside of the United States are those shipped by the American Locomotive Company to the Pekin-Suiyuan Railway in China. Although this ancient country is most inadequately provided with railroad facilities and most of the transportation is still carried on by the same methods that have been in vogue for centuries, this railroad is strikingly progressive. Moreover, it has been built and is now operated solely by Chinese. The greater portion of the line was laid out and constructed under the direction of Dr. Jeme Tren-Yow, chief engineer. After graduating from Yale University in 1881, he returned to his native land and rose to such a position that he was recognized as the most prominent Chinese civil engineer. On his death, K. Y. Kwong, who graduated from the Massachusetts Institute of Technology in 1881, succeeded to the position of chief engineer. Others who have contributed greatly to the success of this railroad are C. C. Wang, director general of railways and S. T. Wang, superintendent of motive power. In working out the design of the Mallet locomotive described in this article, the American Locomotive Company were assisted by K. Y. Kwong and S. T. Wang.

The first section of the Pekin-Suiyuan was built from Pekin to Kalgan, a distance of 122 miles, the work being begun in 1905 and completed in 1909. At this time it was known as the Pekin-Kalgan railway and the funds for the construction were appropriated yearly out of the surplus earnings of the Pekin-Mukden line. Upon completion of the section referred to, the Board of Communication recommended an extension to Suiyuan. This undertaking received imperial sanction in 1909 and construction was commenced in the following year. The length of the second section is 235 miles. This, as well as all other important lines in China, is of the standard gage, 4 ft. 8½ in.

The line runs along the west wall of Pekin and then in a northwesterly direction to Nankow, passing over the West Hills via Nankow Pass, to Kalgan and thence to Fengcheu and Suiyuan. The principal rail connections are at Fengtai with the Pekin-Mukden and Pekin-Hankow lines. About 75 per cent of the revenue received is from freight and the balance from passenger traffic. The heaviest movements are toward Pekin and Fengtai. Fair grades were obtained for the line with the exception of the portion over the West Hills, at which point there is a grade of 3.33 per cent, 11 miles long with uncompensated curves of 600 ft. radius. This grade controls the movement of traffic.



Mikado Locomotive Used on Level Sections

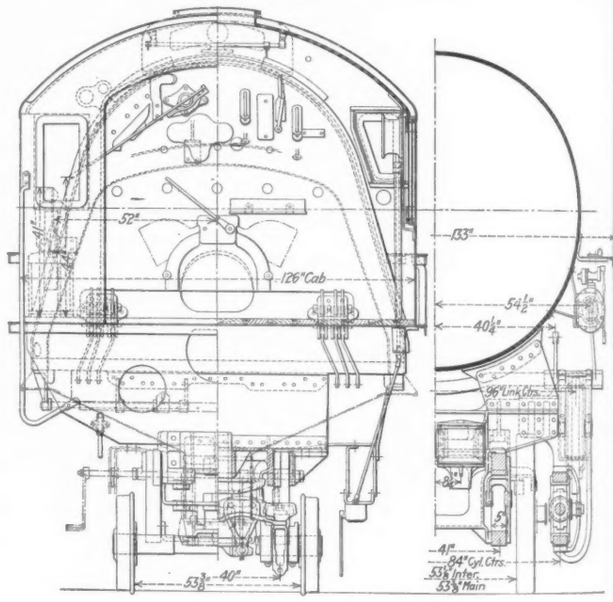
TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Cylinders, high pressure	24 in. by 28 in.
Cylinders, low pressure	38 in. by 28 in.
Valves and valve setting:	
Kind and size, H.P.	Piston 14 in., single ported
Kind and size, L.P.	Piston 16 in., double ported
Maximum travel	H.P. 6½ in., L.P. 6 in.
Outside lap	H.P. 1 in., L.P. 1⅛ in.
Exhaust clearance	H.P. ¼ in., L.P. $\frac{7}{16}$ in.
Lead in full gear	H.P. ⅛ in., L.P. $\frac{3}{16}$ in.
Weights in working order:	
On drivers	388,500 lb.
On front truck	28,500 lb.
On trailing truck	29,000 lb.
Total engine	446,000 lb.
Tender	192,700 lb.
Wheel base:	
Driving, each engine	14 ft. 9 in.
Total engine	53 ft. 11 in.
Total engine and tender	85 ft. 3 in.
Wheels, diameter outside tires:	
Driving	50 in.
Front and trailing truck	30 in.
Tender	33 in.
Journals, diameter and length:	
Driving, main	10 in. by 12 in.
Driving, others	9 in. by 12 in.
Front and trailing truck	6 in. by 12 in.
Boiler:	
Type	Straight top
Steam pressure	220 lb.
Fuel	Bit. coal
Diameter, first ring outside	94 $\frac{5}{16}$ in.
Firebox, length and width	126 $\frac{1}{16}$ in. by 108¼ in.
Height, grate to crown sheet, back	64 in.
Height, grate to crown sheet, front	76 in.
Arch tubes, number and diameter	5—3 in.
Combustion chamber, length	38 in.
Tubes, number and diameter	251—2¼ in.
Flues, number and diameter	48—5½ in.
Tubes and flues, length	24 ft. 0 in.
Tube spacing	¾ in.
Grate type	Finger-bar, rocking
Grate area	95 sq. ft.
Heating surfaces:	
Firebox, incl. coch. chamber and arch tubes	352 sq. ft.
Tubes, outside	3,534 sq. ft.
Flues, inside	1,652 sq. ft.
Total evaporative	5,538 sq. ft.
Superheating	1,433 sq. ft.
Comb. evaporative and superheating	6,971 sq. ft.
Tender:	
Water capacity	10,000 gal.
Fuel capacity	16 tons
General data and proportions:	
Rated tractive force, simple	111,000 lb.
Rated tractive force, compound	92,500 lb.
Weight on drivers ÷ total weight engine	87.1
Weight on drivers ÷ tractive force simple	3.5
Tractive force, compound ÷ comb. heating surface	13.27
Tractive force, compound × dia. drivers ÷ comb. heating surface	664
Firebox heating surface ÷ grate area	3.7
Firebox heating surface ÷ evap. heating surface, per cent	6.35
Superheating surface ÷ evap. heating surface, per cent	2.59
Tube length ÷ inside diameter	143.5

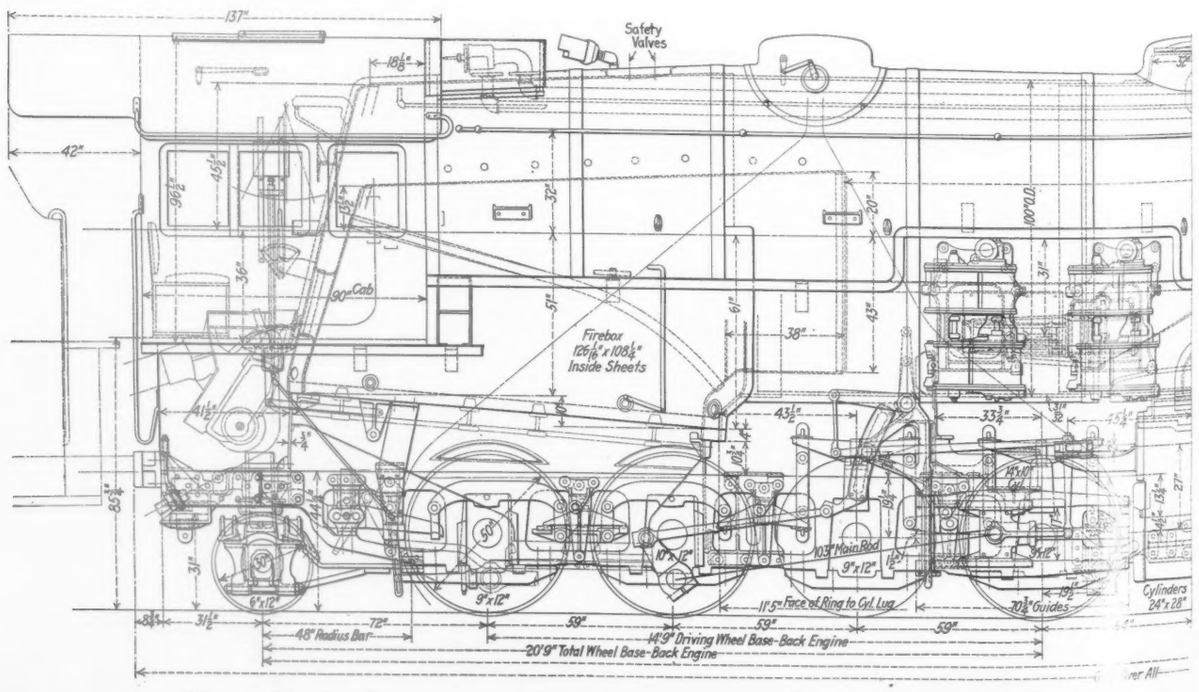
Most of the bridges were fabricated at the Shanhaikevan bridge works of the Mukden-Pekin railroad, while the rails came largely from the Han-Yeh-Ping steel works at Hankow. The majority of the passenger and freight cars were built at the Tongschau shops of the Pekin-Mukden. Practically all the locomotives, however, were built by the American Locomotive Company.

On the main portion of the road, except over the mountains, the heavier freight trains are hauled by Mikado type locomotives. A design largely employed weighs 188,500 lb. of which 137,000 lb. are on the drivers. The rated tractive force is 34,300 lb.: cylinders 20 in. by 28 in.; steam pressure 180 lb., and drivers 50 in. in diameter.

For handling the trains over the heavy West Hills grade it was deemed best to use Mallet locomotives of the 2-8-8-2 type. Those designed for this service have 24 in. and 38



View of Cab and Half Section

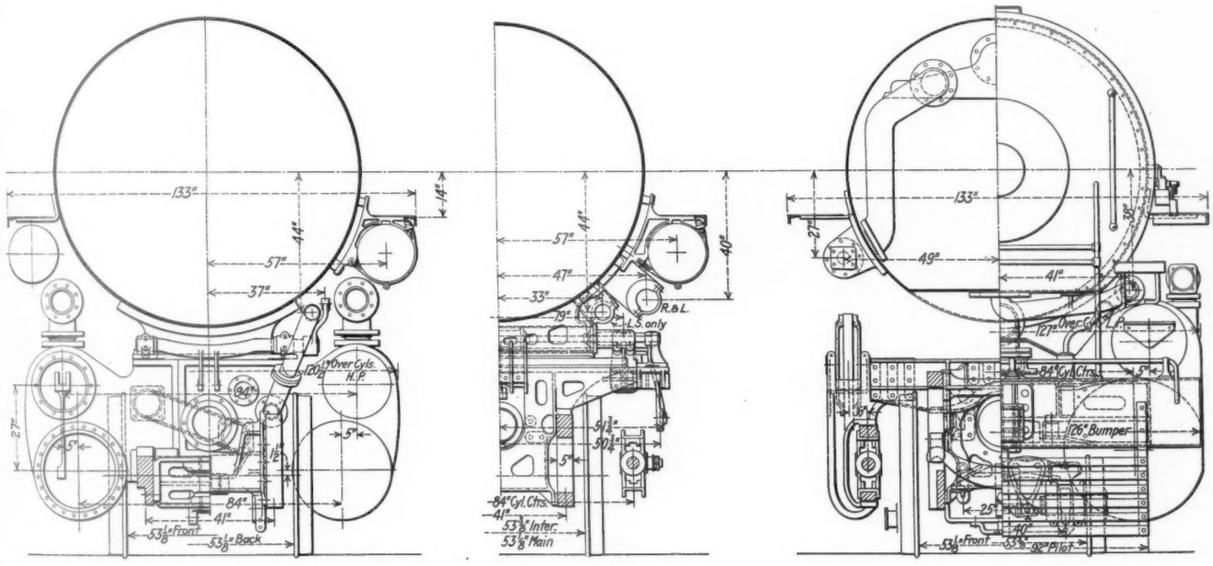


Rear Half of Elevation

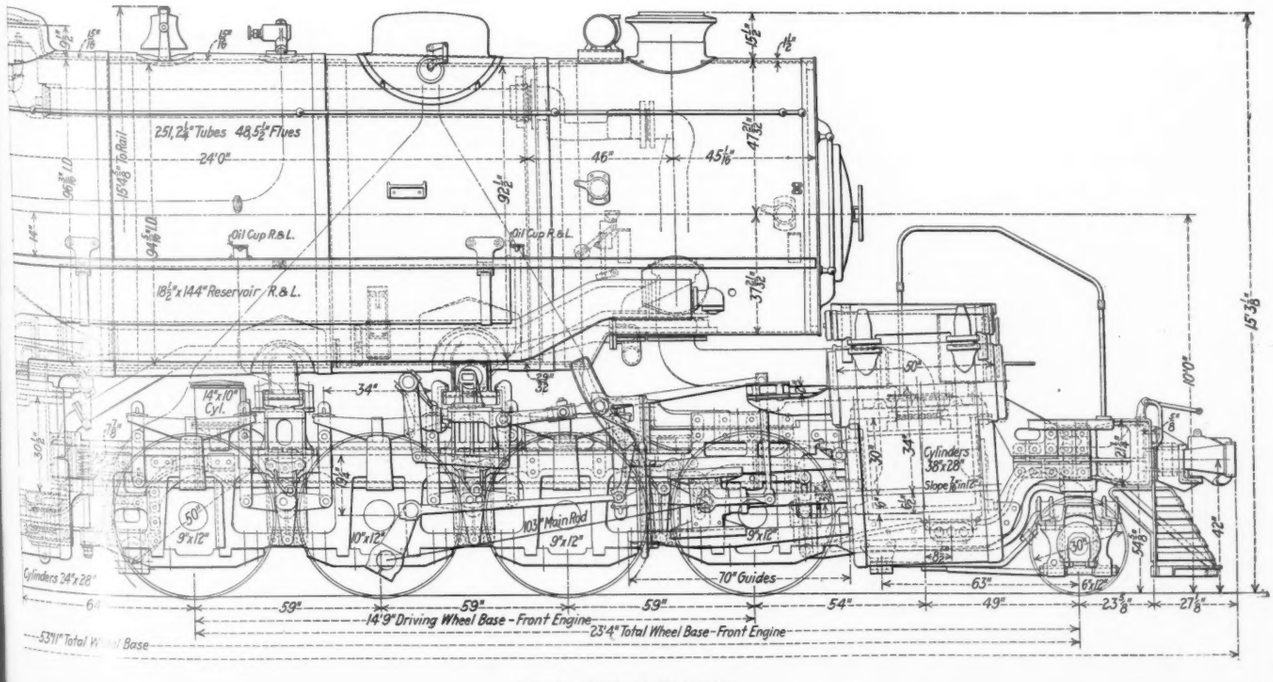
in. by 28 in. cylinders and a rated tractive force of 111,000 lb. when working simple, and 92,500 lb. when working compound. As the weight on drivers is 388,000 lb., the factor of adhesion is 3.5 when working simple and is 4.2 when working compound. The driving wheels are 50 in. in diameter and the boiler pressure 220 lb. These locomotives are capable of handling a freight train of 600 long tons at a speed of 5 m.p.h., or 500 tons at a speed of 10 m.p.h. Two Mallets are required to handle a train which is hauled on the level by one Mikado.

As a matter of comparison it is of interest to note that the U. S. R. A. heavy Mallet locomotives of the 2-8-8-2 type weighed 531,000 lb. of which 478,000 lb. were on the drivers. The rated tractive force was 121,600 lb. simple and 101,300 lb. compound. Cylinders were 25 in. and 39 in. diameter by 32 in. stroke; driving wheels were 57 in. diameter, and boiler pressure was 240 lb. per sq. in.

The general design of the Pekin-Suiyuan locomotives is in accordance with the best American practice, and the special devices are such as would probably be used in this country. The superheater has 48 units. The firebox has a combustion chamber and is fitted with a Security brick arch carried on five tubes. There is an Elvin type A mechanical stoker and a Franklin hand-operated butterfly firedoor. Other well-known attachments included are Nathan Simplex style BH 6,000 gal. capacity injectors, 4-in. Coale open pop safety valves, Hancock pneumatic cylinder cocks, Pyle electric headlight, Leach pneumatic sanders, Gollmar bell ringer, type D automatic couplers, Westinghouse N-12-A friction draft gear, Alco type E reverse gear, Flaman speed recorder and Westinghouse air brakes with two 8½-in. cross-compound air compressors.



Cross Sections and Half Front View



Front Half of Elevation

A Wide Variety of Reclamation Work Is Handled at Huntington

Scrap Reclamation on the Chesapeake & Ohio

Methods Used and Savings Effected in Reclaiming Locomotive, Car and Other Parts at the Huntington Shops

By E. A. Murray

Shop Superintendent, Chesapeake & Ohio Shops, Huntington, W. Va.

In recent years the principal railways of the country have been much interested in the matter of reclaiming locomotive, car and other parts which have been discarded and would ordinarily be sold as scrap. While the Chesapeake & Ohio has not up to the present time invested in a very elaborate reclamation plant, the results accomplished with the facilities available are indicated in the following report and speak for themselves.

Grinding Cast Iron Wheels.—During the year 1921, 466 pairs of cast iron car wheels were ground at a saving of $13.80 per pair, or a total saving of $6,432.03. It requires on an average 45 min. to grind out the flat spots on one pair of wheels. Experience has shown that the investment for the grinding machine pays a good dividend in addition to improving the condition of the wheels. With the great number of car wheels ground at this point we have never had one develop a flat spot after once being ground true. This strengthens the theory that the liability of a ground wheel to slide is much less than if new due to the fact that the ground wheel is truly round. When ground on the axle centers wheels must be concentric with the journals. It is our opinion that the journal bearings of the ground wheels, due to the smoother running of the wheels, are less liable to run hot. Smooth wheels prevent hammer blows which cause the journal box packing to leave the journals. Wheels from the entire system are sent to Huntington for regrinding on the car wheel grinding machine which is illustrated in Fig. 1.

Bolts and Nuts.—During the past year 726,474 lb. of old bolts were reclaimed at a saving of $31,369.62. A great many old bolts are removed from the scrap, straightened, cut off, rethreaded and placed back in stock. This is also true of old rods which are not deteriorated too much.

During the year 1921, 285,505 lb. of nuts were reclaimed by retapping at a total saving of $13,986.76. We use two six spindle nut tapping machines in the nut reclaiming shop which is located at the scrap bins and near the repair yards. The nuts and washers are taken to this shop where the nuts are separated and retapped. The hexagon nuts are then sent to the locomotive department and square nuts to the car department where they are placed in bins conveniently located to the work. The washers are also separated and used in making repairs to cars.

Reclaiming Car Brasses.—Especial attention has been given to the work of reclaiming car brasses. This work is done in the brass foundry and is handled by four men, one

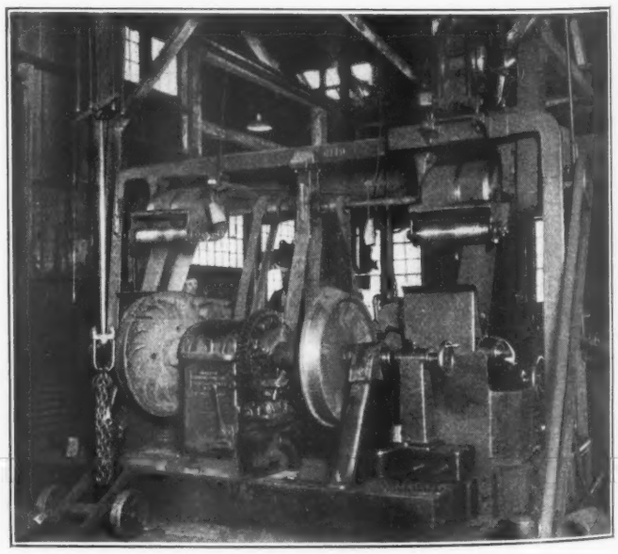


Fig. 1—Car Wheel Grinder Used at Huntington Shops

for sorting and delivering the brasses to the liners, two for relining, and one to operate the car brass trimmer. The equipment for relining brasses is illustrated in Fig. 2 and consists of the necessary babbitt furnaces, tables and forms. It will be noted that each operator works at a table on which

are two forms, arrangements being made for holding the brasses against the forms by means of a small air cylinder and plunger. The babbitt is poured and when cool the operator easily opens a valve releasing the air pressure and the brass. The car brass trimming machine, illustrated in Fig.

Fig. 2—Equipment for Relining Car Journal Brasses

3 is an efficient device, motor-driven through a belt. As in the previous case, arrangement is made to clamp the brasses pneumatically, a straight air valve being used to operate the air cylinder and plunger. Revolving cutters trim the ends of the brasses rapidly and accurately. A pile of brasses reclaimed and ready for service is shown in Fig. 4.

During January of this year 5,667 brasses were reclaimed (weight 136,005 lb.) at a saving of $3.30 per 100 lb., which amounted to $4,490.88. All of the scrap brass and copper

Fig. 3—Motor-Driven Car Brass Trimming Machine

on the entire system is shipped to this point, where it is reworked into new parts. It is not the practice of this company to buy any unfinished brass or bronze castings as all of these castings for the entire system are furnished from this point; also all bearings for new equipment built at outside shops. The illustrations show the old bearings as they are received at the shop, the process of relining the brasses, facing off the ends and the finished product.

Brake Beams.—During the year 1921, 8,079 brake beams were reclaimed at an average saving of $2.46 each, or a total saving of $19,874.34. The large number of brake beams reclaimed was due partly to the fact that a few cars have been let out to outside works for rebuilding, which made it necessary to remove a great number of beams, applying a heavier beam to the cars. These old beams were returned to the Huntington shops where they were put in good condition and used on lighter equipment. The table for assembling brake beams is illustrated in Fig. 5 and while a home-made device, it is effective in reducing the labor involved in assembling brake beams. Fig. 6 shows the furnace used for annealing brake beams.

Car Couplers.—During the past year 3,214 couplers were reclaimed and put in good condition for further service at a saving of $5.37 each, or a total of $17,259.19. A large number of couplers which have been reclaimed, but are minus the yokes, as shown in Fig. 7. Experience has shown that

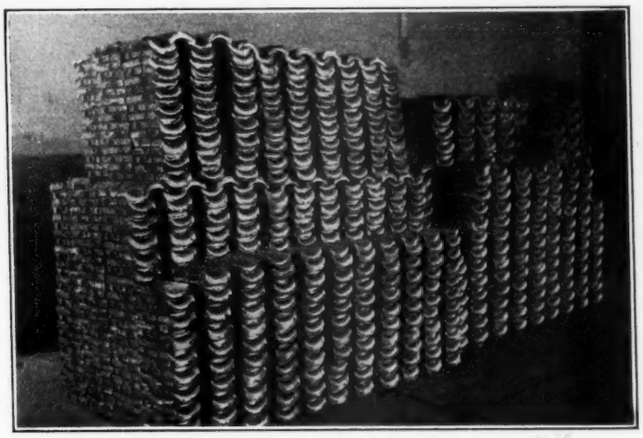


Fig. 4—Reclaimed Car Brasses Ready for Service

where the yoke intersects the couplers is the weakest point of the draft gear on freight cars and to eliminate this trouble we adopted the principle of swelling the coupler yoke rivets under the head to 1 5/16 in. and of sufficient length to have a full bearing in coupler and yoke. The hole in the coupler and yoke is 1 5/16 in. in diameter. It will be plainly seen that with this arrangement the yoke rivets fill the holes in the coupler and yoke and, therefore, make a good substantial job. This practice has been in effect for a good many years and we have never had any trouble with the yokes separating from the coupler when this practice is followed.

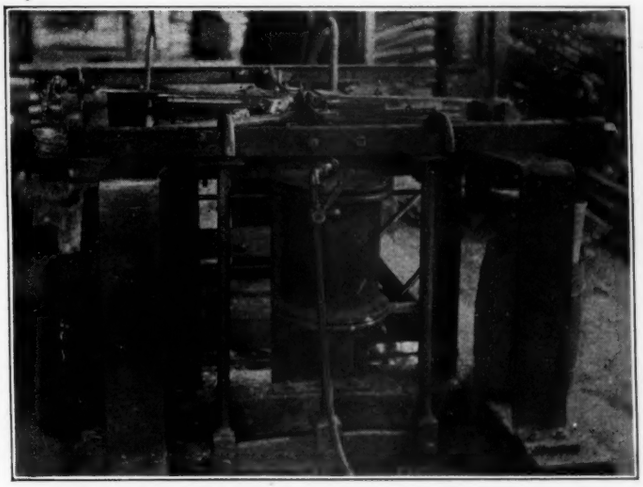


Fig. 5—Air-Operated Brake Beam Assembling Table

We have in our coupler shop one pneumatic riveting machine and one home-made pneumatic rivet shearing machine, illustrated in Fig. 8, which shears the heads off the rivets while they are in the coupler. The home-made machine

consists of a substantial shear blade operated through a long lever by a cylinder and plunger. The construction of the machine is substantial as shown, enabling it to withstand the more or less severe work of shearing coupler rivet heads. A small pneumatic hoist will be observed which facilitates the work of handling couplers and enables the operator to handle a large number in the course of a day without becoming unduly tired.

Rolled Scrap Wrought Iron.—During the year 1921, 1,113,092 lb. of scrap wrought iron were rerolled at a total saving of $20,720.46. All the scrap iron which is suitable for rerolling, including old defective arch bars, is sent to

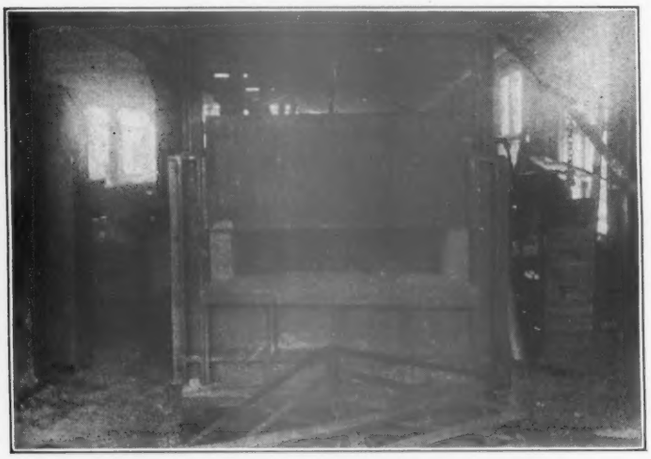


Fig. 6—Furnace Used for Annealing Brake Beams

the reclaiming plant at this point where it is reworked and used in car and locomotive repairs at a large saving. The class of scrap which is rerolled is shown in one of the views at the head of the article.

Coil Springs.—During the past year 885,739 lb. of coil springs were reclaimed at a saving of $38,380.26. The springs are shipped to this point where they are inspected and those with a permanent set are heated, reset, and tempered, after which they are used in repairs to locomotives and cars. They are also shipped to outside points. All locomotive driving, tender and passenger car springs are

Fig. 7—Reclaimed Couplers Without Yokes

repaired at this point for locomotives and cars undergoing repairs; also sent to outside terminals. The average saving is an important item. The coil springs which are broken and beyond repairs are straightened out and the material used for cold chisels, pinch bars, punches and drift pins. We find this practice very economical. The springs which have been reclaimed are given a test at intervals to insure that they have been properly tempered and have the proper resiliency.

Reclaiming by Autogenous Welding.—Reclamation by autogenous welding is carried on at this point to the fullest extent justified by the relative costs of welding or buying new. A few parts which are reclaimed by welding are listed below. While we have no data at hand at present showing the savings made by using this practice, we are satis-

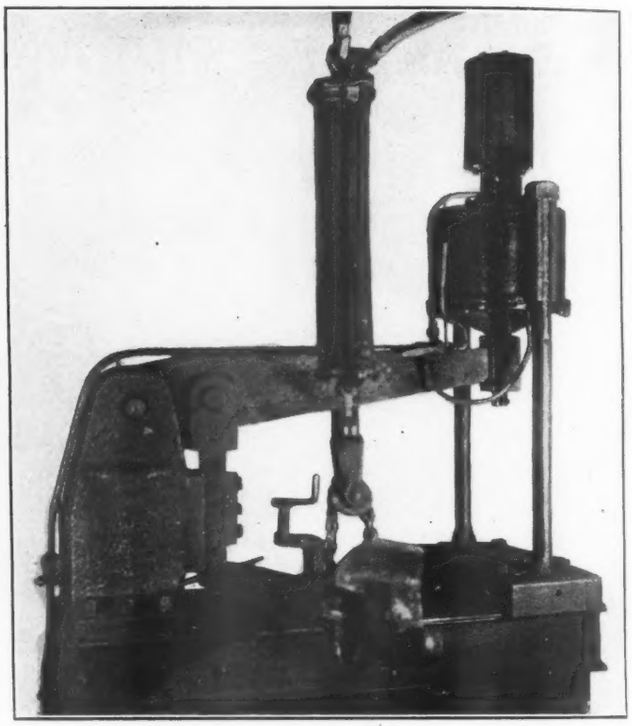


Fig. 8—Pneumatic Machine for Shearing Coupler Rivets

fied that they are very large in the aggregate and compare favorably with those made in important railway shops throughout the country.

List of Parts Reclaimed in Locomotive Department

Engine coupler plates
Main equalizers
Cross equalizers
Spring equalizers
Trailer equalizers
Equalizer stands
Spring saddles
Post hangers
Boss spring hangers
Front end box hangers
Frame cross braces
Deck castings
Smoke arch braces
Reverse bar quadrant
Reverse bars
Reverse bar latches
Plug holes in reverse bar brackets
Plug holes in reverse bar straps
Plug holes in throttle levers
Plug holes in throttle straps
Frames
Driving boxes
Center castings
Expansion pad braces
Expansion pads
Fire door latches
Weld ends of cross bar brake rigging
Fulcrum shafts
Fulcrum arms
Link blocks
Link plates
Link hangers
Links
Link saddles, holes plugged
Radius rod forks, holes plugged
Transmission rods
Transmission hangers
Reach rod forks
Guides built up
Weld bush crosshead holes
Cellar boxes
Trailer boxes
Main rod keys
Main rod front end blocks
Main rod wedges, front and back end
Weld oil cups on side rods
Plug grease cup holes in side rods
Flat spots on tires
Weld pinion to shaft
Weld pinion teeth when broken out
Plug holes in housing
Weld smoke box rings
Weld mud rings
Weld stack brace to boiler
Weld cracks in release bar fulcrums
Weld truck frames
Weld truck cross brace
Weld truck cross brace caps
Weld truck swing hangers
Weld radial jaws
Weld truck boxes
Weld truck bottom braces
Weld truck hound braces
Plug wedge bolt holes in pedestal braces
Weld trailer jaws
Weld frame castings
Weld spiders for piston valve
Weld valve crossheads
Weld valve guides
Combination levers
Tail bars
Chafing irons
Plug holes in back main frame
Boiler head braces
Weld pins for ash pan shafts
Weld stoker castings
Weld collars on stoker screws
Weld castings for stoker trough
Plug holes in lubricator brackets
Reclaim brake hanger pins
Brake hangers (all classes)
Brake heads (all classes)
Weld trailer carrier yoke blocks
Weld trailer spring hangers
Weld trailer carrier yoke hangers
Weld lugs on air pumps
Weld air pumps
Weld cracks in stoker engines
Weld engine cylinders
Weld slide valves
Weld slide valve strips
Weld hub liners
Plug holes in step iron brackets

Reclaim crank-pin washers
Weld dial on knuckle pins
Weld dial on crosshead pins
Weld grate shaker pistons
Plug holes in grate shaker rods
Weld trailer spring carrier yokes
Weld trailer spring carrier brackets
Weld trailer spring carrier bracket guides
Weld universal joints for stoker
Weld crank shafts for stoker
Weld stoker screws or worms
Weld rocker arm for stoker engines
Weld stoker shafts
Guide blocks
Weld cylinder heads
Weld cylinder cock slides
Weld air pump valves
Weld rocker arms
Weld spokes in driving wheels
Weld flag staff
Weld rocker arm boxes
Weld guide yoke boxes
Weld guide yokes
Weld guide yoke extensions
Floating castings
Floating columns
Weld main equalizer hangers
Weld crank arms
Weld strips on cross heads
Weld engine tank side frames
Weld engine tank bolsters
Weld draft castings
Weld draft casting blocks
Weld tanks chafing irons
Weld draft links
Weld main tank frames (cast steel)
Weld cracks in steel end sill
Truck pedestal (Built trucks)

LIST OF PARTS RECLAIMED IN PASSENGER CAR DEPARTMENT

Cast-steel truck frames
Cast-steel truck bolsters
Built up worn equalizers
Plug holes in brake levers
Weld worn places in generator brackets
Weld bumper plates
Weld diaphragm or buffer plates
Weld buffer stems
Weld drawhead stems
Weld wing castings
Weld draft castings
Weld stringer irons
Weld spring blocks (for steel trucks)
Weld motor hanger or bush holes
Weld brake heads
Weld endsill plates
Weld generator shafts
Weld generator pulley wheels

LIST OF PARTS RECLAIMED IN FREIGHT CAR DEPARTMENT

Side frames
Truck frames
Truck bolsters
Body bolsters
Coupler heads
Miner draft castings
Carrier iron supports
Striking castings
Body center plate
Coupler yokes
Lift lever brackets
Door guides
Carrier irons
Draft links
Corner bands
Side bearings
Truck center plates
Spring seats
All kinds of miscellaneous shop tools

Triple valves, angle cocks, release valves, brake cylinders, auxiliary reservoirs and air hose are repaired, tested and placed back in service at a large saving. Globe valves, pipe fittings and miscellaneous items of a wide diversity of character, which usually find their way to the scrap, are reclaimed at a large saving and thrown back in stock. All switch stands which can be repaired economically are shipped to this point where they are put in good condition and placed back in service.

It might be well to state in concluding that we use a unique method at the shops in marking parts which should be scrapped and those which can be reclaimed and used again. This is done by the simple method of marking with white or yellow paint. White signifies that the material can be reclaimed and should be taken to the reclaiming shop; yellow signifies that the part is scrap and should be taken to the scrap bins. The men who are assigned to this work are thoroughly acquainted with the meaning of these marks and we have the assurance of the parts reaching their proper destination. The practice of reclaiming scrap is carried out at other shops on the system, but the main shops being located at Huntington, the work is done here on a larger scale.

Principles of Oxyacetylene Fusion Welding
Part Two: Oxygen

By Alfred S. Kinsey*

ACETYLENE has wonderful possibilities as a gas for producing high temperatures, but in almost every instance its usefulness depends on the combination with pure oxygen to support its combustion. If a jet of acetylene were ignited and allowed to burn like a match,

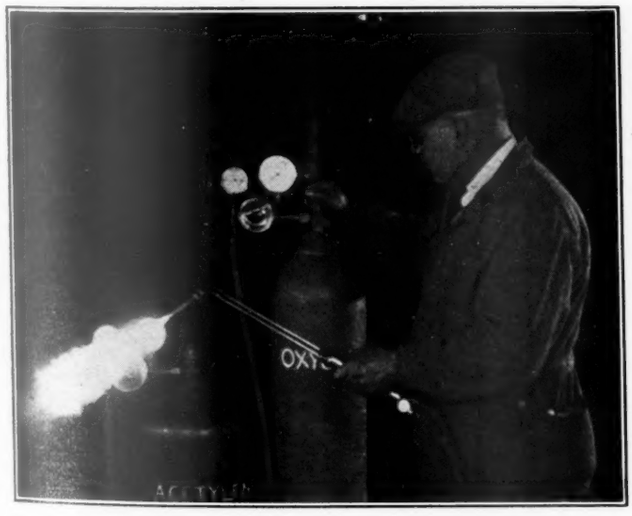


Fig. 1—Burning Acetylene Before Compressed Oxygen Is Supplied

being supplied only with such oxygen as it could get from the ordinary air, it would burn with a low-temperature, smoky flame, Fig. 1, which would cause a shower of carbon particles, lampblack, to fall about, proving that there was not enough oxygen supplied to burn all of the carbon of the acetylene. Such a flame would not be hot enough to weld or cut metals.

If, however, the jet of acetylene were supplied through a blowpipe, like a welding torch, and another jet of pure oxygen mixed with it in the torch, practically all of the carbon of the acetylene would be consumed, and the flame would have a temperature of about 6,300 deg. F.

Now it will be seen that while acetylene has within its composition remarkable possibilities as a fuel gas, it is dependent on an abundant supply of pure oxygen to make them available. And the oxygen must be manufactured and supplied in such a manner and at a price which will make its use practicable, or the advantages of acetylene would be unavailable.

It should be of interest, therefore, to know how commercial oxygen is manufactured and furnished for the multitude of ways it is applied in oxyacetylene practice.

Manufacture of Oxygen

The two common ways of manufacturing oxygen for commercial purposes are by the Electrolysis of Water and by the Liquefaction of Air.

ELECTROLYTIC OXYGEN.—In this method of producing oxygen distilled water is decomposed into its two principal elements, oxygen and hydrogen, by electricity. This is done in special cells, called unit generators, which may be coupled up to make as large a plant as desired. Each cast iron generator is divided vertically by asbestos into two compartments. On one side is a nickel-plated cast iron electrode, called the anode, at which the oxygen is generated. On the other side is another cast iron electrode, called the cathode, at which the hydrogen is generated. The water flows from a

*Professor of Shop Practice, Stevens Institute of Technology and Advisory Service Engineer, Air Reduction Company.

reservoir down into the cell where it is decomposed by an electric current. The oxygen and hydrogen pass upward, each through bell jars to pipes leading to big gas holders. From these holders the gases are taken and compressed into steel cylinders for the market.

This method of making oxygen was one of the first used for commercial purposes. There is, however, liability of the oxygen being contaminated with a sufficient quantity of impurities, to cause an explosive mixture, and insurance rules prohibit the sale of electrolytic oxygen containing more than two per cent of impurities.

In some instances electrolytic plants are erected for the manufacture of hydrogen for the hydrogenation of fats in packing plants, and then oxygen is the by-product. In other instances the electrolytic plant is used to supply oxygen to the trade, which leaves hydrogen as the by-product. Electrolytic oxygen is sold in steel cylinders containing about 200 cu. ft. at 1,800 lb. pressure per sq. in.

Fig. 2—Machinery Room for Manufacturing Liquid Air Oxygen

Liquefaction Oxygen.—The method used to manufacture the largest proportion of oxygen consumed in the United States is by the liquefaction of air, and probably the most successful process for that purpose is the one known as the Claude system. There is considerable machinery about such a plant, Fig. 2, which is used as follows: Ordinary air is made to pass through two towers of spiral tiles, Fig. 3, against a stream of caustic soda, which removes the usual 0.03 to 0.08 per cent of carbon dioxide from the air. The air is then taken into the low pressure cylinder of an air compressor, free of CO_2 but saturated with moisture, which is squeezed from it by compression to 95 lb. per sq. in. The air goes from the low pressure cylinder to a high pressure cylinder, where it is compressed to 450 lb. per sq. in.

So far the air has been purified, compressed and purged of its moisture. It then is made to pass through an exchanger, Fig. 4, circulating around a large number of small tubes carrying cold gases, which reduce the temperature of the compressed air from ordinary room temperature to about 170 deg. below zero Fahrenheit. Next the air is passed through a liquefier and cooled by the incoming cold gases so as to reduce its temperature on down to the point where it becomes liquid. The liquid air is drawn through an expansion valve where it expands from 450 lb. to 75 lb. per sq. in., which lowers its temperature on down to nearly 300 deg. below zero F.

Some of the compressed air, as the rest became liquid, was sent to an expansion engine, Fig. 5, which lowered its pressure to 75 lb. and its temperature far below zero, but it remained in the gaseous form. The combination of liquid air and air vapor is carried over into a vaporizer, where the vapor comes in contact with liquid oxygen and is cooled to where it becomes part of the liquid oxygen. While the oxygen was vaporizing, the nitrogen also was being separated from the oxygen and vaporized. Then the nitrogen vapor became liquid and was collected in the nitrogen pot. Thus the two gases were separated by partial liquefaction.

The next step is to expand the liquid oxygen again through an expansion valve from 75 to 4 lb. per sq. in., which causes its temperature to drop to 296 deg. below zero F., and the nitrogen being likewise expanded is lowered in temperature to 316 deg. below zero F. It is to be noted that it is the expansion of the oxygen and nitrogen in liquid form and not as gases which causes the drop in temperature.

After the further purifying of the two gases, they are taken separately to their storage tanks, from which they are drawn and compressed. The oxygen is charged into steel cylinders containing 220 cu. ft. at 2,000 lb. pressure, Fig. 6.

Oxygen made by this liquid air method is over 99 per cent pure, and the small amount of impurity it might contain would be nitrogen, which is an inert gas having no explosive characteristics.

The Handling of Oxygen

Making oxygen available for use in railroad and other shops has been an interesting problem. It now is quite a common thing to see cylinders of oxygen standing about wherever metals are being worked. These cylinders are manufactured under the rules of the Interstate Commerce Commission enforced by the Bureau of Explosives. They are made of special steel, cold drawn so as to eliminate all longitudinal and circumferential seams.

Fig. 3—Towers for Removing Carbon Dioxide from Air Oxygen

The rules require that the cylinders must be tested at a hydrostatic pressure equal to one and two-thirds times the charging pressure of 2,000 lb. per sq. in., which would be 3,340 lb. The test is performed by filling the cylinder with water while it is submerged in a water jacket. The expansion of the cylinder under pressure may thus be determined by the rise of water it causes in the jacket. The test pressure is held in the cylinder for 30 seconds, and after the total expansion is measured the pressure is released and the permanent expansion noted, which must not exceed 10 per cent of the total expansion. This hydrostatic test must be repeated on every cylinder every five years.

A crushing test is also required in which one cylinder out of every 200 must be crushed between rounded knife-

edges to a thickness equal to six times that of the wall of the cylinder.

All oxygen cylinders passing these tests are stamped with the I.C.C. specification number, the filling pressure and the date.

It will be seen that every precaution known to the art is taken to prevent accidents from the high pressure in the cylinders, and that such care has been successful has been proved by the exceptionally few failures of the hundreds of thousands of cylinders scattered over the whole country.

Fig. 4—Aftercooler for Reducing Temperature of Compressed Air

Air oxygen is distributed in cylinders of 110 and 220 cu. ft. capacity at 2,000 lb. per sq. in. and 70 deg. F., the larger size being the one mostly in use.

The needle valve on the oxygen cylinder is of a special design, which seats tightly at the bottom of the valve to close it, and will also seat at the top when opened all the way, to prevent any leakage about the valve stem. Only the strength of the hand is required to close or open the valve tightly

Fig. 5—Expansion Engine for Lowering Pressure and Temperature of Air

against the seats. The valve handle should not be struck with a hammer or any other tool.

Measuring the Consumption of Gases

The amount of oxygen discharged from a cylinder may be quickly determined from the cubic feet scale on the regulator pressure gage, but it may be more accurately measured by weighing the cylinder of oxygen on a platform scale before and after using the oxygen. The difference in weight in pounds multiplied by 12.08 will give the exact quantity in cubic feet, at 70 deg. F. This applies to the orange colored cylinders of the Air Reduction Company.

The same weighing method of determining the amount of gas used may also be applied to acetylene, the difference in weight, before and after, being multiplied by 14.5, which will give the cubic feet consumed. This applies to the Air Reduction Company's acetylene cylinders.

Combining the Gases

There are two principal types of oxyacetylene welding torches in use, the low pressure injector style using acetylene at a pressure of but a few ounces per square inch, and the medium pressure style using acetylene at a few pounds pressure. The medium pressure torch is conceded to be the most efficient and economical.

Fig. 6—Liquid Air Oxygen Filling Room

Theoretically when one part of oxygen is mixed with one part of acetylene in the medium pressure torch the resulting flame should be neutral, the air supplying the remainder of the oxygen necessary to produce complete combustion. The temperature of this flame is about 6,300 deg. F. at the tip of the incandescent cone. For comparison, the temperature of the thermit reaction is about 5,400 deg. F. and that of the electric arc about 7,000 deg. F. The hardest steels and other shop metals melt at less than 3,500 deg. F.

If the torch is operated with an excess of acetylene it will give a carbonizing flame, while on the other hand too much oxygen will make the flame oxidizing in its action on the metal. It will therefore be seen that it is of first importance to have the welding torch of such design as will readily maintain the proper mixtures of the two gases and keep the flame neutral.

Again, the welder operating the torch must be sufficiently trained to recognize a true flame, even when it is pressed against the metal being melted and the flow of the gases is somewhat retarded by the back pressure.

(To be continued)

A BUILDING AND LOAN ASSOCIATION has been started by the employees of the Pennsylvania Railroad, in the general offices at Philadelphia, to be called the "Broad Building and Loan Association." E. T. Kennan, supperintendent of car service is president and Walton M. Wentz, vice-president; Charles P. Brady is secretary and William Lentz, treasurer.

Swedish Diesel-Electric Motor Car of 250 Horsepower

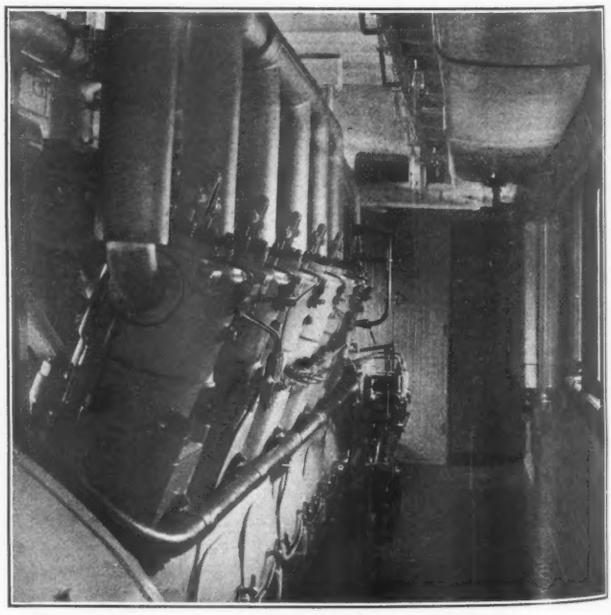
Diesel-Electric Motor Cars for Railway Service

Successful Operation in Sweden Has Led to the Introduction of 250-Horsepower Cars

SWEDEN is one of the countries which is obliged to import its supply of locomotive fuel and consequently the greatly increasing cost of coal is a serious factor in operating expenses. An abundance of water power has made electrification practical on a number of lines where the traffic is heavy but this change is not feasible on a large amount of mileage where the traffic is relatively light. Both improvements in steam locomotives and the substitution of other sources of power are receiving thoughtful attention. Considerable pioneer work in the application of Diesel engines for railroad motive power has already been carried on in Sweden. The system favored uses a Diesel engine to drive an electric generator which furnishes power to motors mounted on the trucks. The first car, built in 1913, had a 75-hp. engine. This was followed by several other cars with the same sized engine and later by others of 120 hp. These cars were built and equipped by the Swedish General Electric Company and the Atlas Diesel Company working in conjunction.

These early motor cars proved to be so satisfactory in operation that a separate company, the Diesel-Electric Car Company, Vasteras, Sweden, was organized to carry on further development work. The new company has turned out several cars of the smaller sizes and in addition built cars of 160 hp. and 250 hp. which are now in regular service. At the present time 12 Diesel-electric motor cars are in service on seven Swedish railroads. That none of the cars delivered has been taken out of service, except when impossible to obtain oil during the war, and that all orders recently received have been from roads that already had at least one car in operation is indicative of the success of the general design.

The cars with 75-hp. or 120-hp. engines were provided with compartments having seating capacity for a number of passengers or with space for baggage and mail. One or more small trailers were commonly hauled. The larger capacity cars lately built are not provided with accommodations for passengers but compartments for baggage and mail have been retained, passengers being accommodated in regular coaches hauled by the motor car.



Engine Room of 250 Horsepower Diesel-Electric Motor Car

Cars of 160 hp. weigh 37,500 kg. (82,500 lb.) and, when grades do not exceed one per cent, are capable of hauling a trailing load of 67½ metric tons (74¼ short tons) at ordi-

nary speeds. This is a total train weight of 105 metric tons (115½ short tons). Cars of 250 hp. weigh 50,000 kg. (110,000 lb.) and under the same conditions can haul a trailing load of 115 metric tons (126½ short tons) which corresponds to a train of 165 metric tons (181½ short tons) including the motor car. Plain trucks are used on the engine compartment end of these cars and motor trucks, one motor for each axle, under the other end. The cars can be operated equally well from either end. With the passenger cars used in Sweden, which are much lighter than are customary on American roads, the 160-hp. car can haul a train with about 225 passengers while the 250-hp. car can haul a train holding 375 passengers.

When hauling full trains the fuel oil consumption for the 160-hp. engine should average about 0.7 kg. per train kilometer or 2.5 lb. per train mile, while the consumption for the 250-hp. engine should average about 1.0 kg. per train kilometer or 3.5 lb. per train mile. Oil records of a 160-hp. motor car for an extended period in regular service handling a train of 90 metric tons (99 short tons) showed a fuel oil consumption of about 0.5 kg. per kilometer or 1.8 lb. per train mile. By weight, the fuel oil consumption of the Diesel engines averages about six per cent of that of the coal used by steam locomotives of the same power.

The 160-hp. engine has eight cylinders and the 250-hp. twelve cylinders but otherwise they are similar in general design to the smaller engines. A number of improvements have, however, been introduced in the later designs of motor cars. The cooling water for the Diesel engines is now recooled in a number of radiators similar to those used for gasoline motor trucks, mounted on the roof of the car as shown in one of the illustrations. Cooling is effected by means of a fan-blower driven directly from the main engine and is thus independent of speed. The motors are now arranged to be connected either in series or in parallel.

In addition to low fuel costs, one man operation and little time or attention required at terminals, experience has shown that Diesel-electric motor cars can make a greater mileage per day, spend less time in the shop and run for much longer periods without a general overhauling than steam locomotives. They are capable of making 50,000 to 60,000 miles per annum. Even after being taken in for overhauling after some 60,000 miles it has been found that the largest item of expense is for dismantling and reassembling.

While the Diesel motor car or locomotive will undoubtedly be still farther perfected and adapted to a wider railroad field of usefulness, indications point to a much more general employment of this general type of motor in the near future.

Correcting Valve Setting Saves $20 Per Trip

Tests Show Slight Inaccuracies in Valve Motion Cause Serious Increase in Fuel Consumption

ONE of the striking peculiarities of steam locomotives is the difference in performance between engines of the same class and apparently in the same condition. Interesting information which shows how details that are often neglected make some locomotives much inferior to others was obtained in comparative tests conducted recently on one of the leading railroad systems of this country. The proposal to test two similar locomotives arose from a discussion of the effect of nozzle sizes, the condition of valve gears, cylinder and valve packing and the size of smokestacks in relation to making schedule time and the economical use of fuel.

For the purpose of comparison two heavy Pacific type locomotives, Nos. 318 and 319, were chosen. They are equipped with superheaters and outside valve gear. The standard valve travel is 6¾ in., the lead ¼ in. forward and backward, the lap 1 1/16 in., and the exhaust clearance 3/16 in.

At the beginning of the tests the only apparent difference between the two locomotives was in the stack and nozzle. Locomotive 318 had the stack bushed to 18 in. at the choke and a 7 in. nozzle. Locomotive 319 had a 6¾-in. nozzle, with a ⅜ in. bridge. Previously this locomotive had been running with a ½ in. split in addition to the bridge, but this was removed just before the tests. The coal consumption of the two locomotives was compared in passenger service and it was found that locomotive 318 used 80 lb. of coal per 1,000 ton miles and engine 319 approximately 100 lb. If the larger bridge had been left in place the fuel consumption of locomotive 319 on the tests would probably have been even higher. This class of locomotive when in good condition will operate best in summer with a 7 in. nozzle and in winter with a 6¾ in. nozzle.

It was felt that the standard 20½-in. stack should give fully as good results as the smaller stack and to determine the cause of the higher fuel consumption of engine 319 the valve motion, valves and cylinders were carefully checked. In examining the engine a large number of minor errors were found. The lead in forward motion on both sides was about ¼ in. but in the backward motion, only about 1/32 in. The lap on the right side was 1/32 in. too great and on the left side, 1/16 in. too great. The distance between ports was 3/16 in. too great on the right side and 7/32 in. too great on the left side. Minor errors were found in the length and throw of the eccentric crank, in the length of the eccentric and radius rods, and in the distance from the center of the cylinders to the center of the main axle.

The combination of these inaccuracies resulted in a serious distortion of the valve motion. The standard travel is 6¾ in. but in this case the actual travel on the right side was 6 in. and on the left side, 5 1/16 in. in full gear. In the running position the cut-off in the right cylinder was 12½ in. on the head end and 15⅛ in. on the crank end and in the left cylinder, 10½ in. on the head end and 13⅜ in. on the crank end. The effect of the incorrect valve setting is clearly shown in the set of indicator cards taken on the early run, shown in Fig. 1. It will be noted that at high speed the horsepower on one end of the cylinder is 36 per cent greater than on the other end and at all cutoffs the cards are distorted.

After these runs the valve motion parts were corrected and the dimensions were made as near as practicable to the standards for the locomotive. With this arrangement the cut-off in the running position in the right cylinder was 8¾ in. on the head end and 9 3/16 in. on the crank end and in the left cylinder, 10 11/16 in. on the head end and 10⅛ in. on the crank end. The indicator cards taken on the next run showed that further improvement could be made in the steam distribution in the left cylinder and the lead on the head end was made 1/64 in. greater than on the crank end. In order to equalize the work on both sides of the locomotive, the valve travel in full gear on the left side was reduced to 6 9/16 in.

The second set of indicator cards (Fig. 2) shows the

results of the changes made in the valve motion. It will be noted that the distribution of work between the two ends of the cylinders is more nearly equal and the valve events are better.

After the valves were set properly the locomotive steamed more freely. It was found that a larger nozzle could then be applied due to improved distribution and more uniform steam flow through the tip, resulting in better drafting and a further reduction in coal burned. The performance of the locomotive was greatly improved and on the last three runs the fuel consumption averaged 73.9 lb. per 1,000 gross ton miles, a reduction of over 25 per cent. What this means to the railroad can be realized from the fact that on this run a saving of 25 per cent in fuel amounts to $20 approximately per round trip.

These tests show conclusively the importance of proper valve setting. The influence of valve motion on the economy of operation of the locomotive is very great. An engine may handle a train and not be reported as unsatisfactory and yet have the steam distribution so defective that it will burn from one-fourth to one-third more coal than is necessary. A fair sounding engine may have poor steam distribution. Enginemen's reports seldom differentiate between locomotives that are out of square due to errors of valve motion and those that sound out due to cylinder packing blows.

In order to correct the defects that were shown to exist in these tests, the railroad is now giving more attention to detail supervision and instructions of shop and enginehouse forces with particular attention to the former. In squaring valves every engine is put on rollers and extreme care is being used in the work, the maintenance forces being impressed with the fact that accuracy in small details has far-reaching effects.

SPEED 25.9 M.P.H.	Crank End	Head End
Card area, sq. in..	3.66	3.62
M.E.P. lb. per sq. in.	95.6	94.5
Hp. 2 cyls.	747	808
Initial press. lb. per sq. in.	140	145
Cut off, per cent..	55.3	55.9
Release, per cent..	88.2	85.1
Compression, per cent.	9.1	12.0
Av. back press. lb. sq. in.	8.62	12.3

SPEED 41.0 M.P.H.	Crank End	Head End
Card area, sq. in..	1.90	2.38
M.E.P. lb. per sq. in.	49.2	61.7
Hp. 2 cyls.	607	786
Initial press. lb. per sq. in.	120	160
Cut off, per cent..	41.4	36.0
Release, per cent..	78.8	82.3
Compression, per cent.	15.5	21.0
Av. back press. lb. per sq. in.	14.5	17.9

SPEED 16.6 M.P.H.	Crank End	Head End
Card area, sq. in.	3.50	3.36
M.E.P. lb. per sq. in.	116.0	111.4
Hp. 2 cyls.	572	568
Initial press. lb. per sq. in.	162	158
Cut off, per cent..	49.2	48.7
Release, per cent.	83.5	83.7
Compression, per cent.	14.7	15.2
Av. back press. lb. per sq. in.	5.30	5.64

SPEED 38.8 M.P.H.	Crank End	Head End
Card area, sq. in..	2.81	2.50
M.E.P. lb. per sq. in.	93.9	83.4
Hp. 2 cyls.	1,081	993
Initial press. lb. per sq. in.	178	174
Cut off, per cent..	42.5	36.7
Release, per cent..	80.0	78.2
Compression, per cent	19.4	18.1
Av. back press. lb. per sq. in.	16.6	17.3

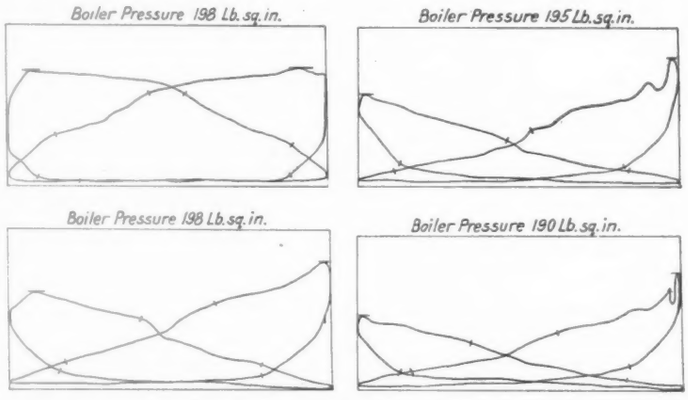


Fig. 1—Indicator Cards Taken Before Errors in Valve Motion Were Corrected

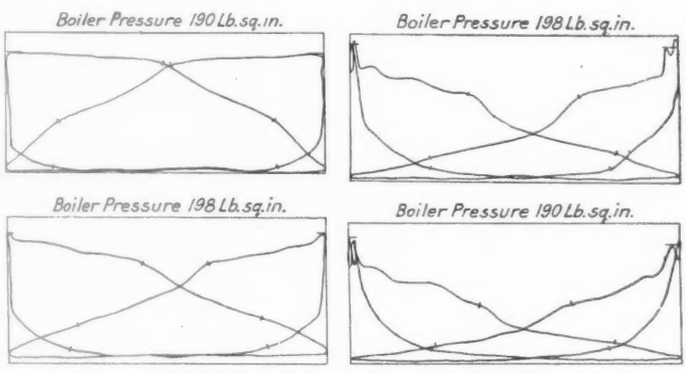


Fig. 2—Cards Taken After Valves Were Properly Adjusted

SPEED 58.7 M.P.H.	Crank End	Head End
Card area, sq. in..	1.45	1.83
M.E.P. lb. per sq. in.	37.7	47.6
Hp. 2 cyls.	666	868
Initial press. lb. per sq. in.	115	155
Cut off, per cent..	46.7	45.5
Release, per cent..	84.7	85.2
Compression, per cent.	13.2	17.1
Av. back press. lb. sq. in.	16.6	17.6

SPEED 68.3 M.P.H.	Crank End	Head End
Card area, sq. in..	1.11	1.47
M.E.P. lb. per sq. in.	28.6	37.9
Hp. 2 cyls.	589	805
Initial press. lb. per sq. in.	90	145
Cut off, per cent..	34.8	38.4
Release, per cent..	83.0	84.0
Compression, per cent.	13.1	16.5
Av. back press. lb. per sq. in.	13.7	19.3

SPEED 60.8 M.P.H.	Crank End	Head End
Card area, sq. in..	2.04	1.83
M.E.P., lb. per sq. in.	66.2	59.3
Hp. 2 cyls.	1,200	1,110
Initial press. lb. per sq. in.	185	184
Cut off, per cent..	35.7	31.1
Release, per cent..	80.5	76.5
Compression, per cent.	24.1	21.1
Av. back press. lb. per sq. in.	20.4	18.8

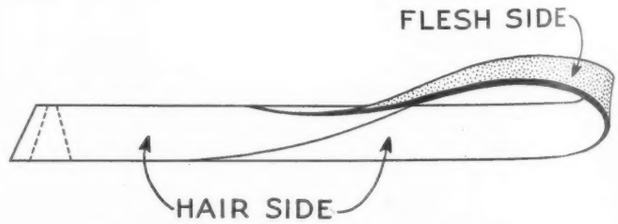
SPEED 69.2 M.P.H.	Crank End	Head End
Card area, sq. in...	1.40	1.16
M.E.P. lb. per sq. in.	45.2	37.4
Hp. 2 cyls.	930	795
Initial press. lb. per sq. in.	172	160
Cut off, per cent..	39.2	32.8
Release, per cent..	79.8	76.6
Compression, per cent.	25.5	23.0
Av. back press. lb. per sq. in.	21.6	20.6

Cutting Leather Belts

By W. F. Schaphorst

Several years ago the writer was taught a valuable kink for cutting belts, as illustrated. Mechanics are usually instructed, when cutting a belt, to use a square and make the cut absolutely square with the sides of the belt. However, if done in the manner illustrated, it is not necessary to make the cut square, the important thing being simply to make it straight. This is done by giving the belt one turn and laying the ends one over the other, in exact alignment. By making the cut straight, even though not square with the sides, it will then be found that the ends will fit accurately.

The cut may make an angle of 45 deg. or even more with the sides without harm. It is usually best, however, to cut the belt square or as nearly square as possible for by this means belting material is more likely to be saved than where the cut is made at an angle. To be doubly sure even if a square is used, it is a good plan to give the belt one turn as explained and if not true, the error will rectify itself.



View Showing Method of Cutting Leather Belt

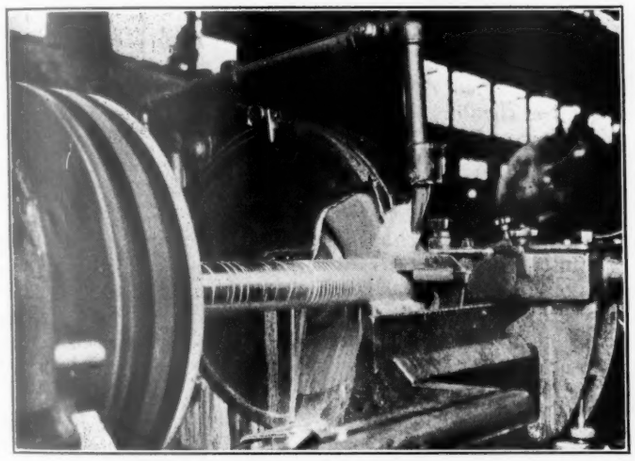
Getting Results From Modern Grinding Machines in Railroad Shops

By M. H. Williams

ARTICLES have appeared from time to time in the *Railway Mechanical Engineer* on the subject of grinding in railway shops but judging by the slowness with which grinders are installed there is need for further education on this subject. Apparently it has not been looked into as thoroughly as the advantages to be gained would warrant.

Abrasive Not Imbedded in Ground Surfaces

The old fallacy has cropped up again concerning the possibility of abrasive from grinding wheels embedding in steel journals and causing them to cut and run hot. Experience and scientific tests have amply proved that no fear of this need be anticipated and as proof attention is called to the piston rods, guide bars, etc., which are ground in railway shops and do not give trouble. Following this subject further: one of the most reliable tool manufacturers in this



Powerful Gap Grinder Truing Piston Rod

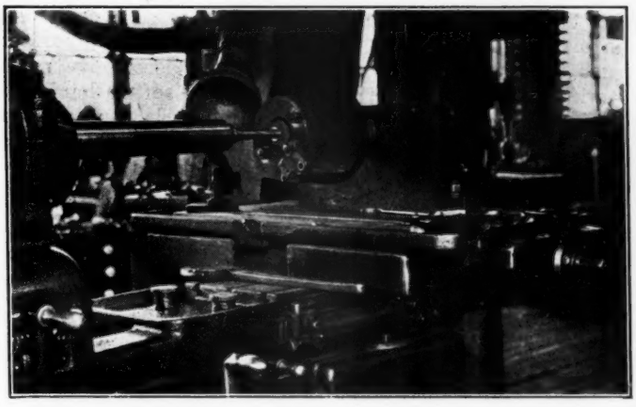
country specifically states that journals and shafts can safely be ground and lapped. Practically all automobile parts and motor shafts are ground owing to the reduced cost and superior finish as compared with other methods. When properly oiled, these do not cut. The bores of automobile cylinders on the better grades of cars are ground. Owing to these being of cast iron, which is more porous than steel, cutting would be expected if the abrasive imbedded in the metal. Hundreds of other cases could be cited of ground axles, shafting, flat surfaces and internal bearings which are operating in a satisfactory manner. Were this not the case, progressive machine tool builders, automobile manufacturers and shops generally would have abandoned this practice long ago. Such plants are installing grinding machines for practically all work coming within their range. Why should the railway shops not do the same?

It may be said in passing that there are ways to grind properly and, unfortunately, ways to grind improperly. As grinding has not been a well recognized practice in a number of railway shops it is feared that this work has not always been done to the best advantage owing to failure to follow necessary details. There are a number of minor details which must be taken into consideration in order to obtain a satisfactory finish and economical production. With the details properly mastered there is no question that the general run of cylindrical surfaces and flat surfaces common in railway work are finished better and more cheaply by grinding than by other methods. A number of matters requiring attention are mentioned below.

Condition of Wheel Surface Important

For all cylindrical work or flat surfaces, great care must be taken to keep the cutting surfaces of grinding wheels in a perfectly true condition by the frequent passing of a diamond, held in a proper holding device, over their surfaces. The principal value of frequent dressing is to clear the surface from imbedded particles of metal. This applies principally to the wheels used on cylindrical grinders; also to a lesser extent to ring wheels used on surface grinders. This truing not only clears the wheels from stray metal but also insures the wheel cutting faster and making smoother surfaces. For piston rod grinding it has been found good practice to pass the diamond over the wheel directly after the low spots are removed. After this dressing the rods are finish ground, resulting in the true and smoothly finished rod so much desired and also leaving the wheel in good condition for quickly roughing down the next rod. With ring wheels used on surface grinders it is now becoming the practice to true the wheels frequently with the diamond in preference to a wheel dresser.

Where the diamond is properly used the diameter is only reduced a small amount which, as far as life of wheels is concerned, is hardly worth consideration. The time required to true a wheel is rarely more than one minute, which is more than made up by the faster cutting. Some question



Typical Internal Grinding Operation

may be raised as to the cost of diamonds. As generally used for railway work, diamonds cost from $15 to $20 each, lasting from one to three months; but this expense is saved many times over by the more satisfactory surfaces, greater output and smaller consumption of power.

Grinding Wheels Should Be Flooded

It appears to be the practice in some shops to operate grinding wheels dry, or with only a small stream of cooling compound. Experience has proved that the wheels should be flooded with cooling compound; the more the better. Cooling compound keeps the wheel and work cool, washing off loose metal chips, abrasive and dirt from the articles being ground. Clear water is at times used as a cooling compound but causes rusting of machine and work. Several good cooling compounds are on the market which make wheels cut more freely and prevent rusting.

Another cause of inferior and slow grinding is the lack of proper steady rests for supporting the work. Articles such as piston and valve rods should be supported by two steady rests and other articles in like proportion. These rests have the effect of backing up the work, allowing more rapid cutting, greater accuracy and smoother finish.

Today the tendency is to traverse the work in front of the wheel more rapidly than in the past, the ideal traverse being from three-quarters to the full width of the wheel for each revolution of articles being ground. Most of the older grinders are not arranged for this rapid traverse which, however, should be large when roughing down, the finish being generally at a slower rate, possibly one-quarter of the traverse used when roughing.

A Free-Cutting Wheel Necessary

The grade and grit of a grinding wheel plays a very important part in the quality of finish and time required. The mistake is often made of using wheels which do not wear away under the mistaken notion of economy. The fact should be borne in mind that a grinding wheel is a cutting tool having thousands of cutting points to the square inch. These points naturally wear and become dull and if they remain in this condition the grinding will be slow and consume an excess of power. If the wheel is softer the dull points break off, presenting new sharp points.

The important problem is to select the happy medium between the wheel that lasts too long and the one that wears away too rapidly and also obtain the wheel best suited for the work. Here is where the grinding wheel experts come in These men make a study of grinding conditions and can generally recommend the proper grade and grit for any particular job. In other words, put the wheel selection up to the grinding wheel maker. If the first wheel does not fill the bill try another, keeping in mind the question of life of wheels versus free cutting qualities, economical and satisfactory output. Also remember that one kind of wheel will not answer to best advantage on soft steel such as is used in piston rods and guide bars, and likewise on hard surfaces such as casehardened knuckle pins. For locomotive repair work it is often necessary to change from soft to hard steel several times a day, where changing wheels consumes too much time. In this event a medium wheel is often used which will best meet conditions for both kinds of metal.

Wheel Speeds and Feeds

One very important point when grinding is the speed of wheel rotation and r.p.m. of the work. As a general rule grinding wheels used on cylindrical and surface grinders should have a surface speed between 5,000 and 6,000 ft. per min. Where these speeds do not exist the pulleys should be changed to obtain this range.

The rate of revolution of work is also a consideration, it being difficult to give a hard and fast rule governing all conditions. For work like piston rods, valve rods, etc., a surface speed of 60 per min. is generally considered satisfactory. This for a 4 in. piston rod equals about 60 r.p.m.

The in-feed of the wheel per pass when roughing down should, as a general rule be all the machine will stand. For work similar to roughing down piston rods, where output is the main consideration, the feed per traverse over the work can be from 0.001 to 0.002 inch. For ordinary surface grinding such as guide bars the feed can be a like amount. The sides of piston packing rings can be ground removing as much as 0.003 inch per revolution of the work. For the finishing operation the feed is reduced. The question of feed can readily be settled on the spot by placing the belts in first class condition, truing the wheel with the proper steady rest, afterwards gradually increasing the feed up to the point where belts slip or articles being ground show signs of chatter or jumping out of the machine. A trial of this kind makes it possible to check up the time required for most grinding jobs.

As an illustration: assume that a piston rod four inches in diameter and three feet long on the bearing surface has been removed from service and requires refinishing. In order to remove all worn spots the diameter must be reduced 1/16 or 0.067 in. Assume that the machine will stand 0.002 in. in feed and a traverse of 1 in. per rev. The r. p.m. of the rod is 60. The wheel would traverse the length of the rod when the latter revolves 36 times and 31 passes or traverses, each reducing the diameter 0.002 in. will make a total reduction of 0.062 in. in diameter. A total of 1116 revolutions of the rod, taking 18½ minutes will be necessary. Allowing one minute for truing the wheel, two minutes extra for slower traverse when finishing and four minutes for handling, this rod should be finished in about 26 minutes. The rod mentioned above, requiring 1/16 inch reduction in diameter was in worse shape than the average. Therefore, the time required should as a general rule be less than that mentioned.

In some shops it has been the practice to turn the rods first in a lathe in order to true down the worn surfaces, afterwards grinding. Advanced practice has shown that with the most worn condition, the rod can be repaired quicker when refinished completely in the grinding machine.

Where Grinders Should Be Used

The piston rod grinder has been principally mentioned owing to its more frequent use in railway shops. The good results obtained clearly indicates that cylindrical grinding machines should be used for other work such as new crank pins, new and repaired crosshead pins, etc. The material in these parts is similar to that in piston rods and the same grinding wheels will answer. In some shops these parts are ground on gap grinders by moving the tail stock up close to the gap. In other shops regular plain cylindrical grinders are installed for shorter pieces. The practice with the new pins of either class is to turn them 1/64 to 1/32 in. large at a very coarse feed, then transfering to grinders and finishing to the required size. By this plan the turning need not be to exact size and can be at as coarse a feed as an engine lathe or turret lathe will stand.

The pins when passed on to the grinder will be rough on their turned surfaces. The humps on the average surface are rarely more than 0.005 in. high which is removed by four or five passes. The grinding is continued until the article is about 0.002 inch large, the wheel then being trued and finish ground to the required size.

Assume that a crank pin is 8 in. long on the bearing surface and 8 in. in diameter. With a moderately strong grinder the pin diameter can be reduced about 0.001 inch per turn, the pin revolving about 25 times per minute. With a traverse of ¾ in. per turn there will be 11 turns per pass. To reduce the diameter 1/32 inch will require 31 passes, equalling 341 turns and taking 14 minutes, or about 16 minutes floor to floor. This is a conservative estimate that can be exceeded on the later grinders.

The general tendency at the present time is to use grinders for all work coming within their range and for all finishing operations in a manner similar to that mentioned above. Owing to the fact that the output of engine lathes, turret lathes or automatic machines can be increased when it is not necessary to hold these machines to close sizes important savings are affected. In other words grinders are used because they save money.

Where case-hardened parts such as knuckle pins, valve motion pins, bushings, etc., are used nothing takes the place of the cylindrical and internal grinders. No matter how carefully the parts are machined and heated they will warp and distort when case-hardened. The only way to insure these being true, fitting properly and having satisfactory bearing surface is to grind them. The cost of grinding is generally offset by the greater production and fewer spoiled pieces.

Mechanical Parts of Electric Locomotives

Comparison with Steam Locomotives; Details of Construction of Outside Frame Type

By H. A. Houston
Railway Mechanical Engineer, Westinghouse Electric & Manufacturing Company

MECHANICAL parts of electric locomotives may be defined as those parts of the locomotive which serve for its foundation, as the running gear and cab. This is illustrated by Figs. 1 and 12, which are end and side views of the mechanical parts of a Baldwin-Westinghouse electric locomotive built for the Chilean State Railways.

Electric locomotives may be divided into two major classes, namely, outside frame and inside frame locomotives. The former class includes those types of construction in which:

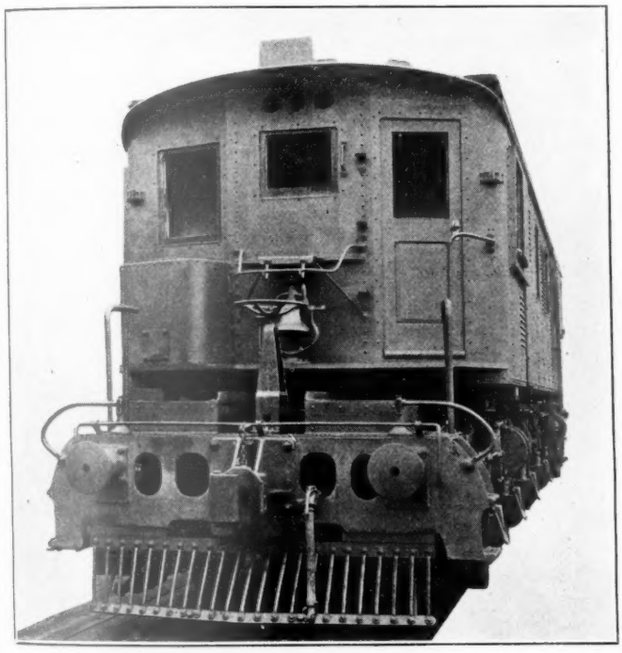


Fig. 1—End View of an Outside Frame Electric Locomotive for Foreign Service

first, the driving motors are mounted on and geared to the axle; second, the motors drive the axles by means of quills and springs; third, the motor armature is concentric with the driving axle. The latter class typifies construction, embracing: first, direct side rod drive in combination with a counter-shaft or jack-shaft; second, gear and side rod drive through a jack-shaft.

In this paper, it is intended to comment on the construction of mechanical parts of the type utilizing outside frames, and axle-mounted motors with gear drive.

Comparison With Steam Locomotive Design

The electric locomotive possesses a peculiarity in that its design characteristics embody the fundamentals of both the steam locomotive and the modern all steel passenger car. Essentially it is one or more steam locomotive wheel arrangements, or running gears, with the equivalent of a car body resting upon it. The cab may be mounted directly on the main frame or have a center pin and side bearing support on each driving truck.

The similarity in the design of mechanical parts for electric and steam locomotives, constitutes one of the most logical steps in perfecting the art of electric locomotive design and construction. However, there are a few differences, such as double-end operation, the lack of conformity between driving wheel diameter and class of service of the locomotive, etc., which require diligent study to predetermine the tracking characteristics for a particular design.

The wheel size is dependent on the gears, motor and clearance under the gear case. This results in a variety of wheel sizes for the same class of service and is a design limitation. Electric locomotive design, contrary to that of the steam locomotive, may embrace large diameter driving wheels, as 80 inches, for freight or pusher locomotives, and small diameter driving wheels, as 42 inches, for passenger locomotives. Further, the designer is limited in the number of driving axles, the weight per axle, rigid wheel base, etc., and at the same time must, for competitive and other reasons, keep the total weight to a minimum.

Tracking Characteristics

The study of tracking characteristics generally includes: (1). Wheel arrangement. (2). Class of service. (3). Height of center of gravity. (4). Relation of cab length to center pin distance. (5). Method of articulation between driving trucks under one cab and between the cabs. (6). Behavior of locomotive and limiting position of the running gear on curves as restrained by the wheel flanges against the rail head. (7). Behavior of locomotive on tangent track. (8). Track stress.

One of the best aids for making a study of tracking characteristics of locomotives is the "Roy" diagram. The

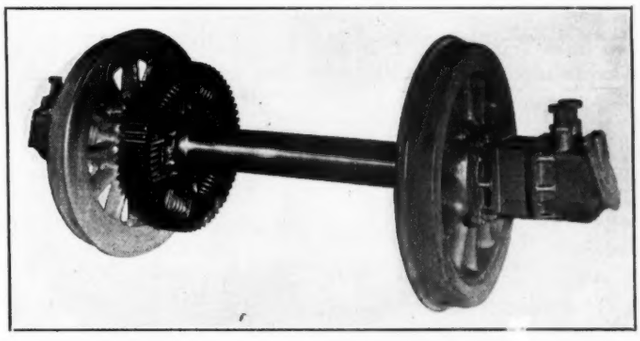


Fig. 3—Driving Axle Ground Finish from End to End with Flexible Gear, Wheels and Boxes Mounted

"Roy" method will determine whether a locomotive with a certain wheel arrangement can actually pass through a curve when running in either direction. It will quantitatively indicate the cramping of the various wheels, enabling one to determine the set-up laterals or the necessity of using blind tires on certain pairs of wheels. Idle or weight carrying trucks can be investigated for proper functioning with radial action only, or with the addition of set-up laterals. Other studies on tracking characteristics can be made by this method. An illustration of the use of the "Roy" diagram is shown in Fig. 2. In this figure a 260+262 wheel ar-

rangement is used in order to show the effect of the guiding axle and radius bar length, whereas the photographs shown herein are for an 060+060 wheel arrangement. However, both locomotives are substantially alike except for the idle axle at each end. The former is a passenger locomotive and the latter a freight locomotive. The notes on the diagram are self-explanatory.

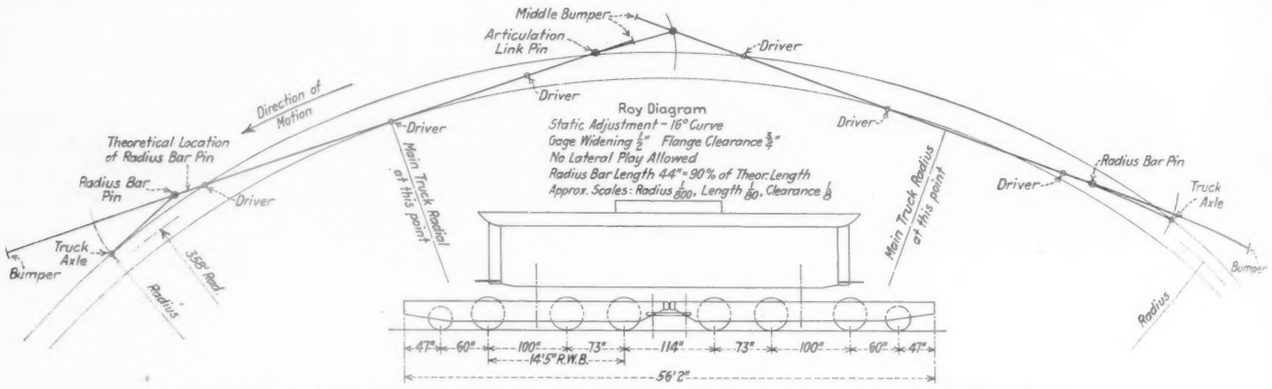


Fig. 2—The Roy Diagram Shows Whether Locomotive Will Pass Through Curve

Track stress analysis may be made along the lines indicated by the report of the Joint Committee of the A.R.E.A. and A.S.C.E.

Factors Affecting Design

Two of the remaining features connected with the design

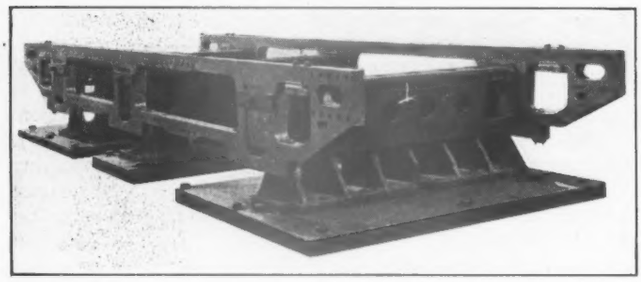


Fig. 4—Jig for the Accurate Assembly of Main Frames, Cross-Ties and Bumpers

are most important; they are first cost and maintenance. The former is dependent upon the weight, type and simplicity of design of the locomotive; the latter upon strength

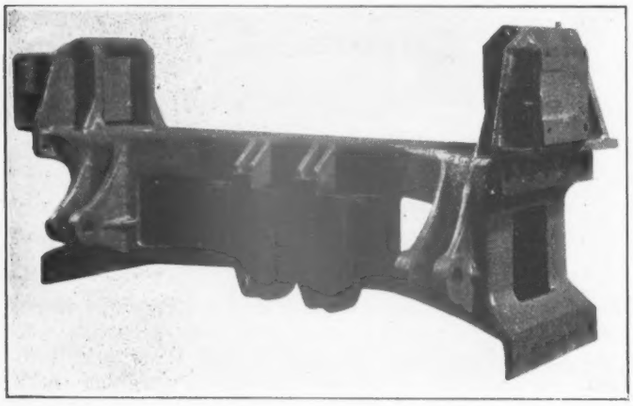


Fig. 5—Main Frame Cross-Tie with Motor Nose Spring Support in Position

of materials, simplicity of design and ease of inspection and repairs. As stated heretofore no attempt is here made to go into the details of design. However, it is pertinent to draw attention to the general conditions which determine the structure.

In addition to the static weight per driver at the rail, steam locomotive design must necessarily consider the additional effect due to dynamic augment. The influence of this effect is oftentimes felt in the design of electric locomotives by having the axle loading at the rail limited to the same amount. This is not necessary, due to the absence of reciprocating movement and the more perfect balance of all rotating parts. Advantage should be taken of this fact.

In the following paragraphs a brief description of the major mechanical parts is given with illustrations of their construction and assembly.

A pair of mounted driving wheels with journal boxes which have grease plugs for lubricating the hub liners is shown in Fig. 3. Fig. 4 depicts a jig or template upon which the main frames, cross-ties and bumpers are assem-

Fig. 6—Main Truck Bolster Casting Which Receives Center Pin Loading

bled. These are arranged to properly gage and locate the several parts.

Fig. 5 shows one of the cross-ties machined ready to be placed in position. Attached to it is the spring support for the motor nose which is used to give the motor an easy riding effect, to cushion vibrations and permit movement and adjustment as required by the tracking conditions. This suspension also acts as a stop for the safety lugs which are mounted upon the motor, in case the motor nose fails.

Fig. 6 portrays the main truck bolster casting, which carries the female center pin casting. This is spring supported and provided with four side blocks which act as cross-heads and are held by the guides shown on the cross-

ties in Fig. 5. Such construction permits the center pin location over a driving axle or at any intermediate point between truck cross-ties.

After the main frames are properly tied together the assembled frame is moved forward to another assembling table where all the necessary fixtures are added as shown in Fig. 7, and the whole finally trammed and checked before going to the wheeling pits. Attention is drawn to the fact that where outside frames are used the distance between centers is 82 in. instead of 42 in. as with inside frames. Also there is no diagonal bracing, therefore it is necessary to provide cross-ties and bumpers with sufficient strength and rigidity to receive their portion of vertical and impact loads in conjunction with the main frame without undue stress or distortion. With these salient features accepted each cross-tie, bumper and main frame should be so designed that the resultant fibre stress due to vertical bending under direct loading plus that due to lateral bending, does not exceed a predetermined value. Where cross-ties and bumper beams are cored out to permit the passage of levers, piping, etc., the sections at such points should be carefully investigated and designed to give proper section moduli.

The application of the springs and equalization system after the main frames are mounted on the wheels, along with coupling the trucks together at the articulation joint, presents a view as shown in Fig. 8. The locomotive running gear is now ready to have the center pin distance checked, after which the cab is placed in position upon the trucks.

The design and construction of the cab underframe for proper strength is a problem which receives earnest consideration. Unlike a car underframe there is not sufficient room below the floor for the center sills, as all the space between the wheels is filled with motors and electrical equipment apparatus. Fig. 9 illustrates the framework of a cab underframe. It will be seen that one center pin is restrained in both the fore and aft position, whereas the other is restrained laterally only. These underframes must be built to possess sufficient strength to withstand repeated stresses from vertical bending in conjunction with the effects of surge and lateral stresses. It is ordinarily true that heavy electric locomotive cabs do not carry the draft gear, as the buffing force is carried through the main frames. But it is further understood that a cab cannot be relegated to the back shop for repairs, as a car body may be sent to the rip track for frequent attention. Too much investment is tied up in the locomotive, sometimes 50 to 75 times as much as in a car.

The super-structure framework of the cab is shown in Fig. 10. This is built with templates and secured to the underframe. Likewise the ends are built on forms and to templates as depicted in Fig. 11. As in the case of the

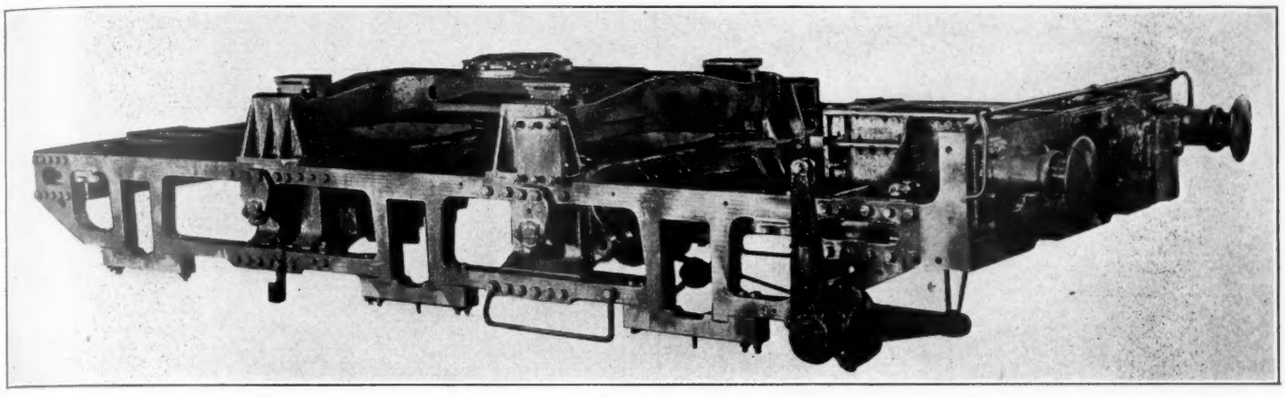


Fig. 7—Main Truck Frames with Cross-Ties, Bumper Beams and Truck Bolster All Assembled

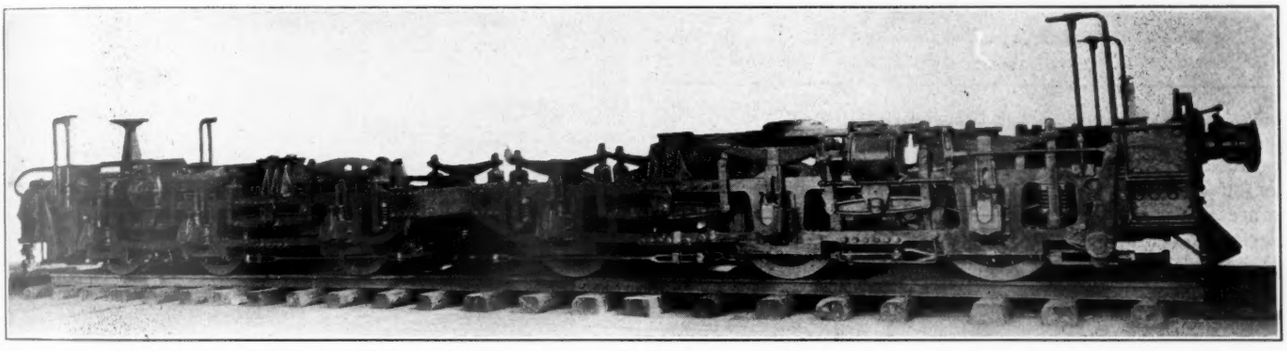


Fig. 8—Running Gear Assembled

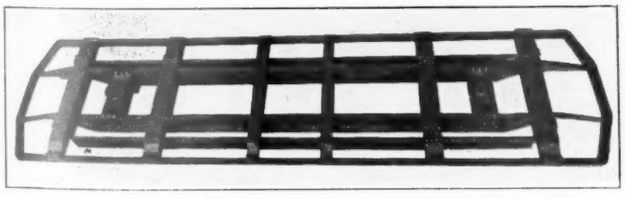


Fig. 9—Electric Locomotive Cab Underframe

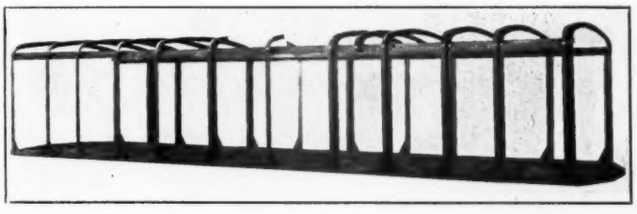


Fig. 10—Electric Locomotive Cab Superstructure Framing

running gears the work is very exact and all parts are thoroughly interchangeable. The side sheeting is then applied, also floor and deck work. After painting the assembled mechanical parts appear as shown in Fig. 12.

In following the various steps above indicated in the design and construction of mechanical parts of electric

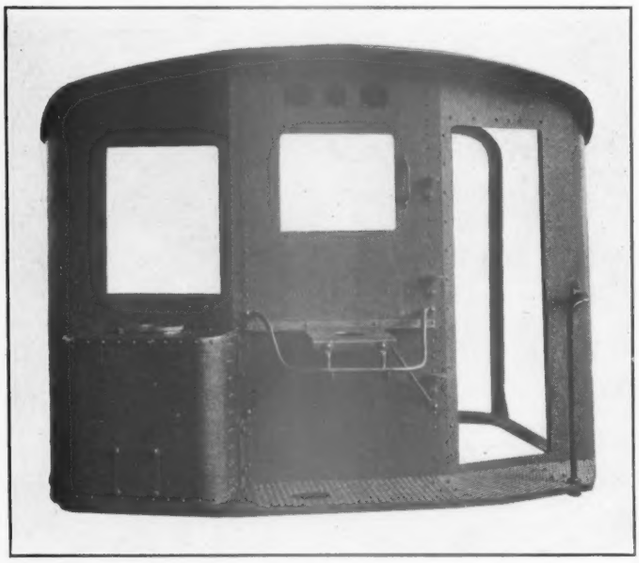


Fig. 11—Electric Locomotive Cab End

locomotives, simplicity is paramount; first for cost; second for maintenance. Inspection as a component of maintenance is most important. Unlike the steam locomotive the electric locomotive is expected to work continuously for 24 hours in every day for several days, as the lubrication,

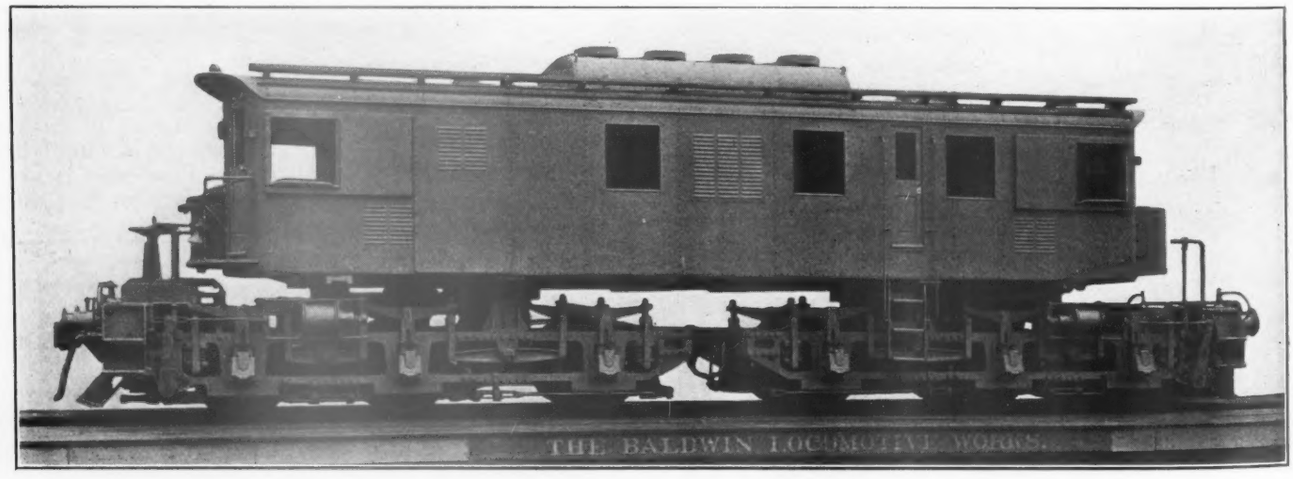


Fig. 12—Assembled Mechanical Parts of an 060-060 Electric Locomotive without Electric Equipment

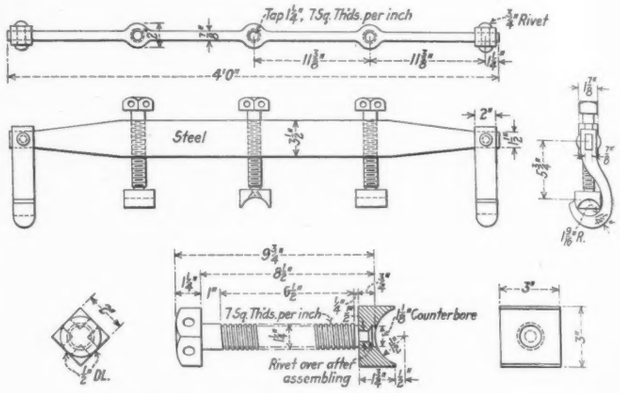
cleaning and trip inspection can be given when changing crews or when on passing or side tracks. It is not unusual to require from 10,000 to 12,000 locomotive miles per month, with continuous runs as long as 750 miles, all of which can only be done when inspection and maintenance are assured. The solution is simplicity.

The Illinois Central has furnished its employees in Mississippi with cards containing a statement of the road's annual operating costs in that state. The number of employees in the state is 9,424 and the amount paid out yearly in wages is given as $13,645,052. Material and supplies purchased and taxes paid amounted to $3,003 572. This statement will be a "talking point," for employees who come in contact with the public.

Tool for Straightening Arch Pipes

By E. A. Miller

WHEN locomotive arch pipes become bent owing to overheating, supporting excessive weights, or any other cause, the tool shown in the illustration can be used to straighten the pipes quickly and without the expenditure of very much energy. The device consists simply of a beam,



Details of Arch Pipe Straightening Tool

two hooks and three screw bolts, the details and arrangement as assembled being illustrated.

The body of the beam has a cross section of ⅞ in. by 3½ in., being made of steel with the ends tapered and squared to allow for the application of hooks. Three bolts, having 1¼-in. square threads, seven threads per inch, are provided to screw into the beam as shown. The head of each bolt is square and drilled with ½ in. holes for the insertion of a small bar to give greater leverage in turning. The other end of each bolt is turned down to ½ in. and after being turned into the beam, half round blocks are applied, as shown in the illustration. The ends of the bolts are then riveted over to hold the blocks from falling off but not enough to prevent swiveling.

In straightening an arch pipe this tool is applied so that the convex side of the bend is toward the beam and the pipe is readily straightened by turning the screws the right amount, a method which shows considerable savings over what it would cost to remove the bent pipe and apply a new one.

Boring Bar for Air Cylinders

By J. H. Hahn

IN ordinary shop practice air compressor cylinders which become worn in service must be unbolted and removed from the center castings in order to be placed on the mill for reboring. Breaking the center casting joints and rebolting requires considerable time and expense which is avoided by means of the portable boring bar shown in the illustrations. The boring bar is self-centering and requires practically no setting up. The radial drill as illustrated in Fig. 1 is probably the best type of machine for the operation.

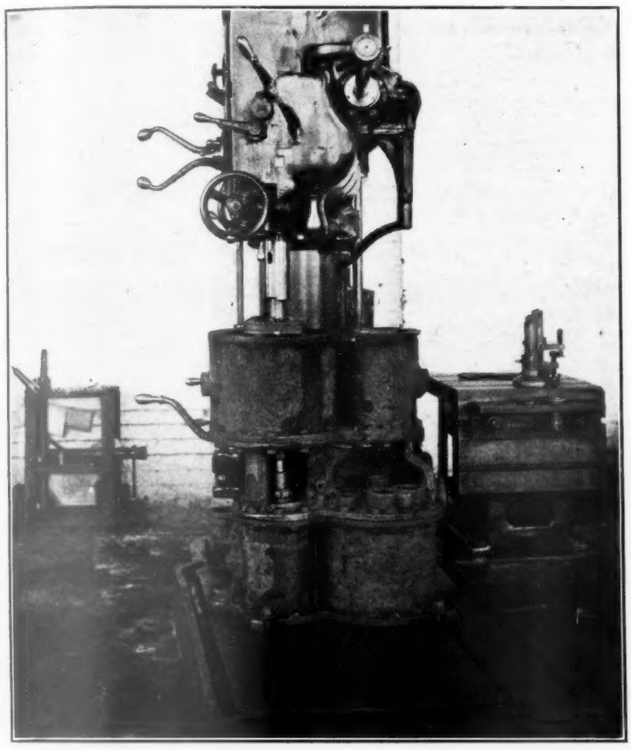


Fig. 1—Radial Drill Equipped With Cylinder Boring Bar

A cross-section through the air compressor and boring bar is given in Fig 2 which also indicates the boring bar arrangement when assembled. It will be noted that a taper shank on the boring bar proper is arranged to fit in the drill spindle. The boring bar is accurately guided by means of two sleeves held against the stuffing boxes by means of the nuts shown. Two sizes of tool holders are provided, one for the high and one for the low pressure cylinder, each being arranged to carry two tool bits 180 deg. apart. As shown in the detail drawing (Fig. 3), these tool bits are readily adjustable in and out and held firmly by means of bolts with taper heads.

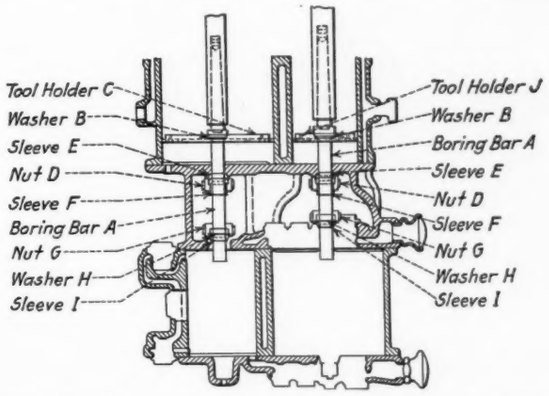


Fig. 2—Cross Section Showing Boring Bars Assembled for Use

The self-centering feature of the boring bar will be evident from an examination of the drawing, also the ease of setting up. This boring bar is being used with considerable success on the Norfolk & Western.

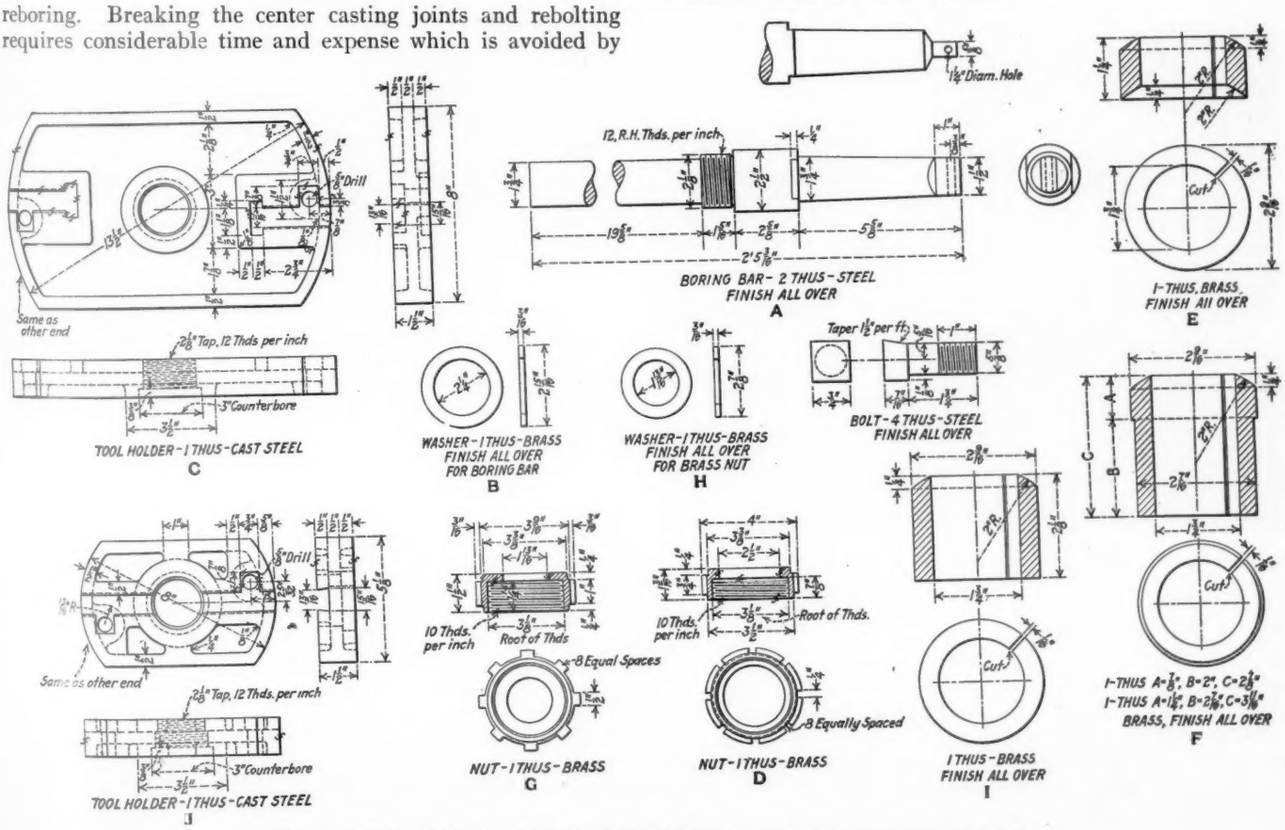


Fig. 3—Details of Boring Bars Used for Truing Worn Air Compressor Cylinders

Renewing Fireboxes at Sayre

THE method of renewing fireboxes at the Sayre shops of the Lehigh Valley, while not particularly new, effects a material saving in repair costs. Briefly the operation, as shown in Fig. 1, consists of cutting the rivets along the throat sheet, mud ring and up over the wrapper sheet so

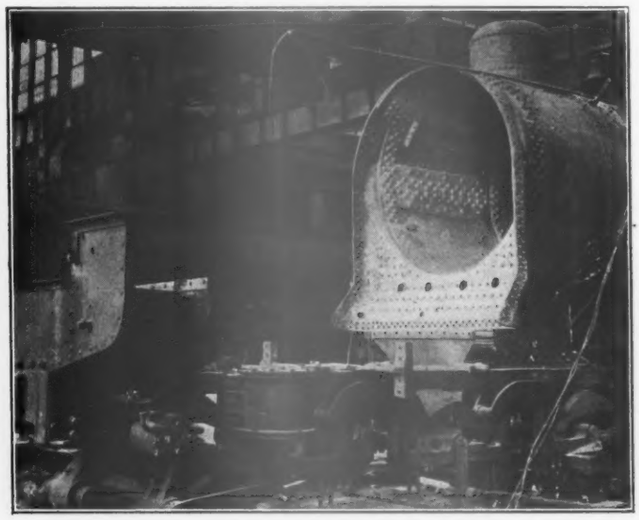


Fig. 1—View Showing Boiler Back End Removed for Application of New Firebox

that the entire back of the boiler can be removed and sent to the boiler shop for application of a new firebox. It is comparatively easy to strip the cab and fittings which would have to be removed in any case, and little time is required to cut off and punch out the rivets. Then the work of applying a new firebox, being performed in the boiler shop, is

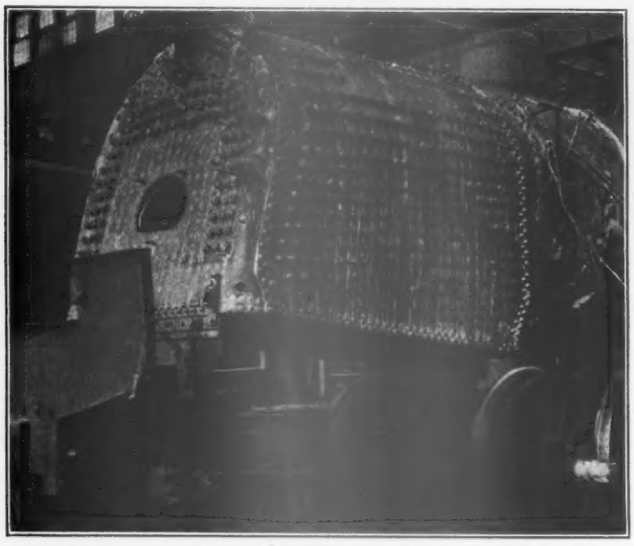


Fig. 2—View of Boiler with New Firebox Applied

conveniently located for workers and supervisors. When the new firebox is applied, the back end of the boiler is sent back to the erecting shop and fitted in place, new rivets being driven in the old holes as shown in Fig. 2.

This method of renewing fireboxes has a big advantage, both as regards labor and material costs, over the former method of disconnecting and removing the entire boiler from the engine frames. In that case it is necessary to strip the jacket, lagging and fittings from the entire boiler, all running boards and brackets also being removed. Cylinder saddle bolts and expansion pads must be removed.

It takes two men about 16 hours to disconnect and remove the back of the boiler, as shown in Fig. 1, and about 20 hours are required to put it back in place and rivet it, as shown in Fig. 2. The old method of removing the entire boiler would probably take four men about 24 hours and approximately twice as long to put it back on again, including the time required to ream saddle bolt holes and drive new bolts.

Crown Bolt Drilling Device

In connection with applying new fireboxes, a device has been developed at Sayre, as shown in Fig. 3, for drilling, tapping, facing off and driving crown bolts. These operations formerly required a staging built in the firebox and the boilermaker who operated the standard air motor was obliged to work in cramped quarters, feeding the drill or

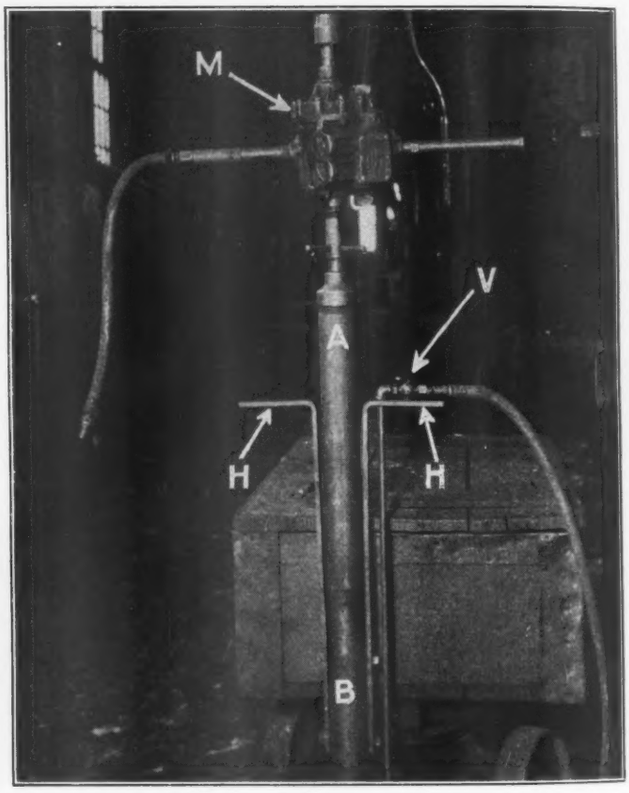


Fig. 3—Device for Drilling Crown Bolts

other tool upward by means of the motor feed screw. To facilitate performing this work, the device shown in Fig. 3 was made, consisting essentially of one section of 2½-in. pipe *A* (to which is attached the air motor *M*) turned down at the lower end and packed to make a sliding, air tight fit in a similar pipe section *B*. This lower section of pipe acts as a cylinder so that when the air pressure is turned on through valve *V* pipe section *A* together with motor *M* is forced upward. The combined length of pipes *A* and *B* is sufficient to reach from the level of the grate bars to the top of the firebox and pipe *A* has sufficient travel in *B* to accommodate variations in this distance. The lower end of *B* (not shown in the illustration) is provided with a ball joint, and two handles *HH* facilitate handling.

In operation the device is set up under a crown bolt to be drilled and the air pressure turned on. This forces the pipe section *A* and air motor *M* against the crown bolt and when the air motor is started, provides automatic feed. Much less time is required for drilling crown bolts with this device than by former methods.

Railway Shop Grinding Practice in England

Interesting Machines Developed for Grinding Locomotive Cylinders, Car Journals and Mounted Crank-Pins

It is generally conceded by those in a position to know that English locomotive and car repair work in many details is carried out with greater accuracy than is considered necessary in American practice. Possibly this is the reason that grinding as a machine operation has been received so favorably and introduced so extensively into English railway shops. While most of the grinding machines are relatively smaller and lighter than those of American make there is no doubt that they have been developed to handle a far greater diversity of work.

In addition to many types of cylindrical, surface and internal grinders, a machine has been developed for grinding crank-pins mounted in the wheel centers. This machine, made by Beyer, Peacock & Co., Ltd., Manchester, England, resembles in appearance an American quartering machine into which the driving wheels are set and clamped at the required position. The grinding head is located in a horizontal position, the planetary principle of grinding being used to rotate the revolving spindle and grinding wheel around the crank-pin as it is held in the wheel center. An arrangement of eccentric sleeves enables the wheel to be fed up to and over the crank-pin in truing it. The outer edge of the grinding wheel is rounded over so as to provide the necessary filet on the crank-pin shoulder. This machine could doubtless be used for grinding crank-pins on American locomotives but only in the smaller sizes as English crank-pins are seldom over six or seven inches in diameter.

Another interesting English machine is a double vertical spindle hole grinder corresponding to the duplex rod boring machine familiar in American railroad shops. Boring bars and cutting tools are replaced by spindles and grinding wheels revolving in two similar wheel heads. These duplex wheel heads are adjustable along the base of the machine to suit different lengths of rods and the vertical grinding spindles have automatic feed for truing the holes. The double spindle rod grinder is made by the Churchill Machine Tool Company, Broadheath, Manchester, England, as is also a locomotive cylinder grinding machine which has no counterpart on the American market and a plain grinding machine for truing worn car journals.

Grinding Locomotive Cylinders

Any suggestion to grind locomotive cylinders would probably be looked on with considerable skepticism in this country but this operation is actually performed in English railway shops, as shown in Fig. 1. It will be noted that the cylinders are a new pair of the inside type, fitting between the locomotive frames. The grinder is of ample power and capacity to handle this work, the claim being made that grinding affords the most rapid and accurate method of finishing cylinders smoothly to size.

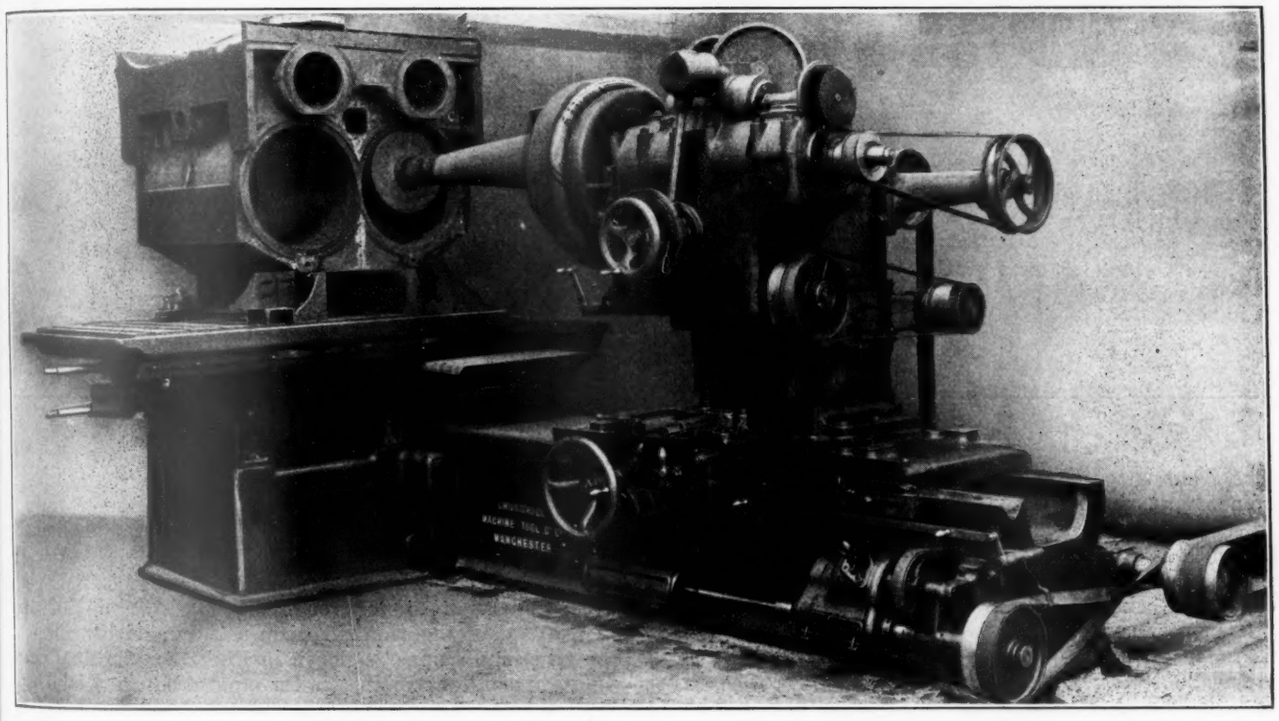


Fig. 1—Churchill No. 3 Internal Cylinder Grinder Truing a Pair of English Locomotive Cylinders

In general the practice is to rough bore the cylinders on a horizontal boring machine and finish them to size on the grinding machine illustrated. The cylinders are bored within .020 in. of the finish size, the remainder of the metal being removed by grinding. An accuracy limit of .0012 in. for both roundness and parallelism is claimed, this enhanced accuracy in machining locomotive cylinders tending to provide greater efficiency and longer life.

The general construction and operation of the Churchill No. 3 cylinder grinder is evident from the illustration and need not be entered into at great length. Briefly the locomotive cylinders are supported on a heavy table provided with cross adjustment only for positioning the work, the

table remaining stationary during the grinding operation. The table is carried on a base reaching directly to the floor and rigidly bolted to the other section of the machine. The grinding wheel and spindle of generous proportions are provided with the necessary planetary motion and are carried on a slide with a 12-in. vertical adjustment on the column. The column is mounted on a horizontal slide provided with automatic rotary motion along the heavy bed and controlled by adjustable reversing dogs for varying the stroke to suit the length of hole to be ground. This slide is provided with three changes of speed for eccentric motion and five for the traversing motion. There is also additional quick traverse.

Grinding Car Journals

The grinding of car axle journals has been developed quite extensively in England and Fig. 2 illustrates the type of machine used for this purpose. It has been supplied to most leading English railroads and car manufacturers. The advantages of grinding may be summarized briefly as follows: The journals are more accurate and hence have longer life with less tendency to produce hot boxes. The journals are smoother with a similar result. The cost of truing by grinding is less than by turning and rolling due to the fact that it is more rapid and present labor charges are high.

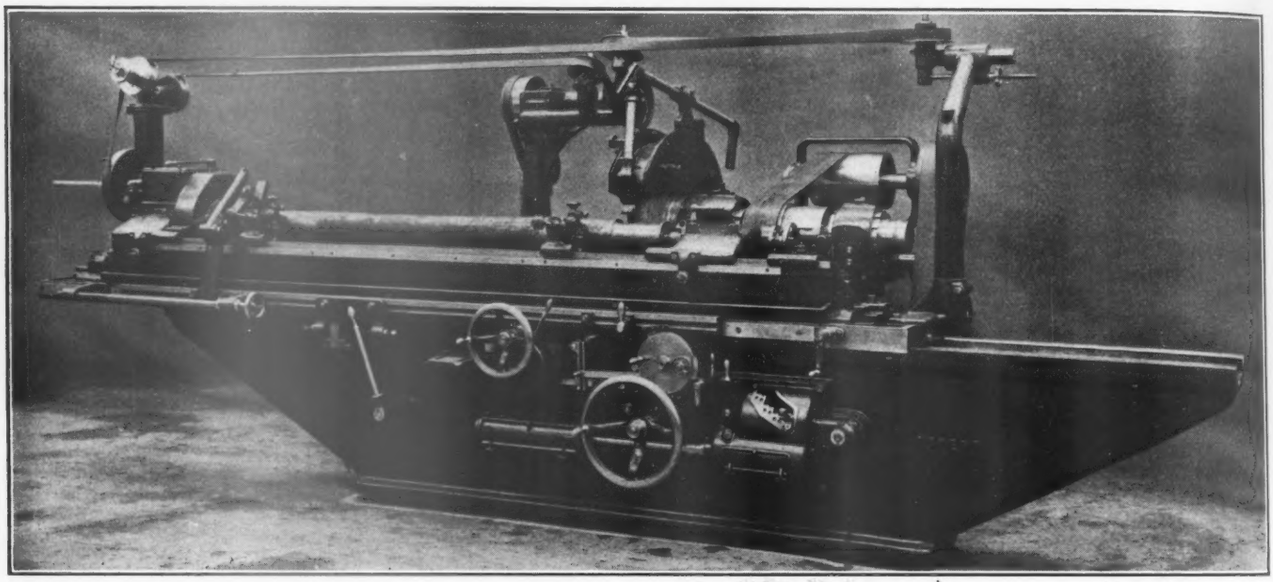


Fig. 2—Churchill Plain Cylindrical Grinder Used for Finishing Car Axle Journals

The grinding wheel spindle is easily detached on the main spindle and can be changed in a few minutes for larger or smaller holes. A large range of adjustment to the grinding wheel is available so that wheels can be used considerably smaller than the holes to be ground. The machine is self-contained, being driven by a direct-coupled motor.

The machine illustrated is capable of grinding cylinders 22 in. in diameter by 48 in. long, but two smaller grinders are available and it is understood that a still larger one has been made with a capacity up to 32 in. in diameter by 84 in. long, being developed especially for grinding Diesel engine cylinders. This machine would be large enough to grind American locomotive cylinders if it were considered advisable to follow that practice but the cylinders would have to be removed from the frames. If a portable cylinder grinding machine could be made, an interesting possibility would present itself in the use of cast-steel cylinder bushings, bronze-faced pistons and cast-iron cylinder packing rings. It would be interesting to determine whether the increased life of bushings and rings, fewer locomotive delays due to defective cylinder packing and steam economy due to accurate fitting rings would not more than offset the increased cost. It would, of course, be useless to provide accurate cylinders and piston packing without similar attention to the valve chambers and main valve rings.

While American railroads are not now, and possibly never will practice the grinding of locomotive cylinders, there are many smaller cylinders which practical railroad men say should be ground instead of simply bored. Among these may be mentioned air compressor cylinders, cylinders of feed water pumps and other large cylindrical parts. If the 22-in. by 48-in. grinder is considered too large for this work, one of the smaller sizes can be used.

In addition, a smaller amount of stock is removed to true up a worn journal. Consequently the journal can be trued a greater number of times before it is down to the limit of size and has to be scrapped.

In general, the method of machining journals in English railway shops is to first rough turn them within .020 in. to .030 in. of the required diameter, transferring them to the grinding machine as shown in Fig. 2 for the final operation. The ideal combination for rapid production is to have two machines on the rough grinding operation and one finishing as the roughing down takes just twice as long as finishing. Removing the above-mentioned amount of metal from the wheel seats and journals and finishing the journals takes from 30 to 35 min. per axle. The positioning device on this machine takes care of the accurate dimensioning demanded in the spacing of the journals and obviates any possibility of errors in this connection due to varying depths of center holes.

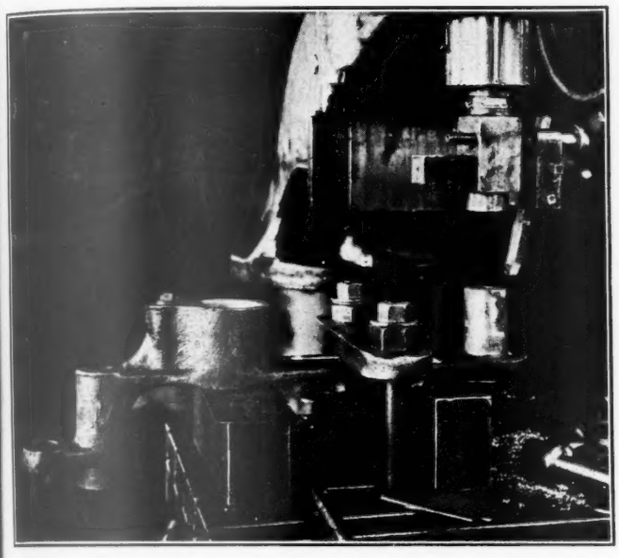
Drill Press Turning and Facing Tool

AN effective and convenient tool for performing turning and facing operations on a drill press is shown in the illustration. The particular operation indicated consists of truing a worn Baker valve gear yoke and facing off electric welding which has been applied to take up side play. This operation is performed at the Portsmouth shops of the Seaboard Air Line.

On account of the shape of the valve gear yoke it is difficult to clamp on a vertical faceplate and to swing it on a boring mill requires a large table, so it is advantageous to handle it on a drill press.

The tool consists of a steel cutter ground with the proper rake and clearance and held in a block forming part of the square horizontal section which is an accurate running fit in the fixture attached to the drill spindle. Horizontal movement of the square section and therefore of the cutting point is controlled by the handle indicated at the right, attached to a long screw through the body of the fixture.

It is evident that in using this tool the drill spindle is lowered until the point of the cutting tool comes down to the



Upright Drill Equipped with Adjustable Turning and Facing Tool

surface to be trued. The handle is then turned to give a chip of the required thickness when operation of the drill press will turn a cylindrical surface, of the required length. When the cutting point of the tool gets down to the required depth the spindle feed is stopped and with the spindle revolving slowly the handle is turned a little on each revolution, gradually feeding the cutting tool out. This trues up the metal deposited by electric welding, leaving a shoulder which is smooth and square with the cylindrical surface.

Reduced Cost of Thermit Welds

As a result of an investigation it has been found that economies amounting to 10 per cent or over can be made in the amount of Thermit required to make Thermit welds. This is accomplished by reducing the size of the collars or reinforcements of Thermit steel; also, by narrowing the gap and changing considerably the proportions of gates and risers, it is possible to weld the smaller sections, such as 2 in. by 3 in. up to 4 in. by 6 in. with very much less Thermit than was ever believed possible before. For instance, a weld on a 2-in. by 3-in. section for which 40 lb. of railroad Thermit was previously recommended, now can be made with only 10 lb of Thermit. On a 3-in. by 4-in. section, where 55 lb. was formerly recommended, 25 lb. only is needed, providing the size of collar, width of gap and size of the various gates are proportioned in accordance with the dimensions now found best. On the average locomotive frame section, of about 4-in. by 6-in., the new method will give a perfect weld with a saving of over 10 per cent in the Thermit required.

Investigation has proved that in no case will the saving for the average frame be less than 10 per cent when this new method is followed while, on the smaller sections the saving runs into larger figures especially when advantage is taken of the use of pneumatic rammers, smaller mold boxes and other labor-saving devices which have been introduced in the past year.

The accompanying table gives the width of gap, width and thickness of collar, size of gates and quantity of Thermit which should now be used in welding all sections from 3 in. by 2 in. in size up to 7 in. by 7 in.

WELDING PORTIONS FOR WELDING LOCOMOTIVE FRAMES

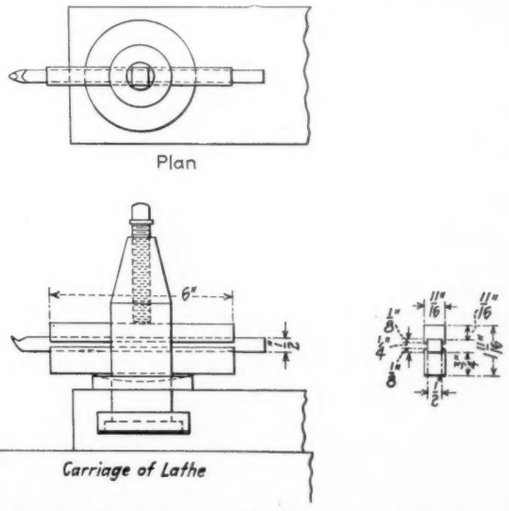
Width of frame (inches)	Depth of frame (inches)	Width of gap (inches)	Width of thermit steel collar (inches)	Thickness of thermit steel collar center (inches)	Heat gate (Dia. in inches)	Pour gate (Dia. in inches)	Riser (Dia. in inches)	Recommended Amount (pounds)
3	2	½	2½	½	1	1	1¼	10
3	2½	5/16	2¾	5/16	1	1	1¼	12
3	3	⅜	3	⅜	1	1	1½	16
3	3½	7/16	3¼	7/16	1	1	1½	20
3	4	½	3½	½	1	1	1½	25
4	4	⅜	4	⅜	1¼	1¼	2	40
4	4½	⅜	4	⅜	1¼	1¼	2	45
4	5	⅜	4	⅜	1¼	1¼	2	50
4	5½	1	4½	1	1¼	1¼	2	60
4	6	1	4½	1	1¼	1¼	2	65
4½	4½	1	4½	1	1¼	1¼	2¼	60
4½	5	1	4½	1	1¼	1¼	2¼	65
4½	5½	1⅛	5	1⅛	1¼	1¼	2¼	70
4½	6	1⅛	5	1⅛	1¼	1¼	2¼	75
5	5	1⅛	5	1⅛	1¼	1¼	2½	75
5	5½	1⅛	5	1⅛	1¼	1¼	2½	80
5	6	1¼	5½	1¼	1¼	1¼	2½	85
5	7	1¼	5½	1¼	1¼	1¼	2½	90
5½	5½	1¼	5½	1¼	1¼	1¼	2¾	85
5½	6	1¼	5½	1¼	1¼	1¼	2¾	90
5½	7	1¼	6	1¼	1½	1½	2¾	105
6	6	1¼	6	1¼	1½	1½	3	100
6	6½	1¼	6	1¼	1½	1½	3	115
6	7	1⅜	6½	1⅜	1½	1½	3	125
6½	6½	1⅜	6½	1⅜	1½	1½	3¼	130
6½	7	1⅜	6½	1⅜	1½	1½	3¼	140
6½	8	1⅜	7	1⅜	1½	1½	3½	150
7	7	1⅜	7	1⅜	1½	1½	3½	150

*Diameters shown above for pouring gates are mean diameters. In practice these pouring gates should be tapered, the bottom diameter being approximately ¼ in. less and top diameter approximately ¼ in. greater than the dimensions given.

High Speed Steel Tool Holder

By E. A. Miller

The tool holder illustrated differs from others in that the high speed steel tool bit need not be broken into short lengths but can be fed forward as necessary. It can be used on small shapers and when used on a lathe can be set at the proper height with relation to the work by means of a small curved



Tool Holder Designed for Use with Long Tool Bits

adjusting piece which fits into a corresponding concave washer. The holder is 6 in. long and 11/16 in. wide, the groove being made for ⅜ in. or ½ in. tool steel in this size. For use on large shapers, planers or lathes, the holder can be increased in size. The parts are made of machine steel and held in the tool post as any ordinary tool.

WHAT OUR READERS THINK

Building Up Sharp Driving Wheel Flanges by Autogenous Welding

DEER LODGE, Mont.

TO THE EDITOR:

In the April number of the *Railway Mechanical Engineer* I noticed an article on building up sharp flanges by welding. The Chicago, Milwaukee & St. Paul has been doing this on large electric freight locomotives for about ten months, doing the welding with the electric process. At first tire steel drawn out into welding rods was used, but we are now buying nickel steel, using the ¼-in. rod and obtaining much better results.

Electric welding is preferable to acetylene, for the reason that with the electric welding it is possible to make what we call a cold weld. The metal of the tire is not heated except at the point of the weld, and by welding about three inches and then skipping three inches we do not have the danger of high local heating. We have found this to be the dangerous part of welding tires both for flat spots and flange welding.

About 100 flanges have been welded to date and there have been no failures due to welding and have had to rebuild only two that were previously welded. They had made 11,000 miles.

Apparently we are going to get very good mileage from the welded flange. We do not turn the flanges after welding, but make a very smooth job and then fill in the crevices with hard pin grease. This gives sufficient lubrication to do away with any cutting that might start due to roughness of flanges, and in a very short time the flange is perfectly smooth.

Inasmuch as we are shopping our equipment on a mileage basis, this serves to keep the motors in service up to the time when we can take them into the shop and also makes a large saving as to maintenance without removing drivers. If the truck is removed from the locomotive we have to pay for the removal of the truck wheels, the stripping of the armature from the truck and the wheels for turning and then have the tire loss due to the turning of the tire for a new flange.

However, from past experience I do not believe it is desirable to weld flanges after the wheel tread has run approximately 100,000 miles for the reason that the rolling effect on the tread causes a hardening of the surface of the tread which in time will cause contractions that will develop into hair cracks and then later on into breakage of tires. On a road with which I was connected, I had an experience of this kind on tires which made a large mileage between turnings due to the small flange wear on account of straight track.

We have found by our experiments that the acetylene welded flange costs more to weld. It takes higher heat at the point of the weld, this heat having considerable spread through the body of the tire and causing more or less distortion of the metal in the tire, which puts it under considerable strain, increasing the tendency for breakage, while as above stated, the electric welding heat is very much localized and the operator can at all times place his hand on the tread of the tire near the point welded, as it practically remains cold.

E. SEARS,

Division Master Mechanic, Chicago, Milwaukee & St. Paul.

Unbalanced Steam Pressure on Pistons

SCHENECTADY, N. Y.

TO THE EDITOR:

I have read with interest the communication in reference to unbalanced steam pressure on pistons by Thomas E. Stuart, published in the April issue of the *Railway Mechanical Engineer.*

I cannot agree, however, first with the inference that an unbalanced pressure due to the exclusion of steam from between a portion of the wearing face and the cylinder wall—if such a thing be possible—is any greater on a Z-type piston, having the limited wearing face, than it is on any other form of piston of the same width and arrangement of rings.

All pistons are turned smaller than the bore of the cylinder when applied, and are therefore surrounded by steam to the first packing ring and to some extent at least to the opposite ring. If then we assume that it is possible to exclude the steam from under any portion of the wearing face, the piston, no matter what the shape, will bear on the barrel to an extent equal to the actual area, not the projected area, of the surface affected, times the steam pressure.

Second, it is inconceivable to me that any piston through service could "grind" itself to the absolutely perfect contact with the lower wall of the cylinder barrel for the entire length of stroke which would be required to exclude the thin film of steam necessary to balance the pressure.

If it were possible for such a condition to occur, it would be possible also for the packing rings to wear to a similarly perfect contact with the barrel for their entire circumference, and therefore be loaded with, for instance, 12,000 lb. on a 27 in. diameter ring and this, of course, is not the case as the wear of the rings will testify.

I believe the contention in regard to an unbalanced pressure on any piston is practically without foundation and that where excessive wear between piston and barrel occurs the cause is mechanical—poor lubrication, improper alinement, inadequate driving facility, etc.

The American Locomotive Company has applied Z-type pistons having the 90 deg. bearing and reduced upper portion to the majority of locomotives with cylinders over 23 in. in diameter, built by the company in the last eight years, probably 3,000 or 4,000 engines. That this design of piston has been satisfactory is a matter of record.

The service given by the old design of box piston which was the American Locomotive Company's standard equipment prior to the adoption of the single plate type, is certainly unquestionable. Yet this piston, the use of which dates back to the beginning of things, has the same width of bearing, although continuous, as the corresponding diameter of Z-type and is therefore subject to the possibility of the same unbalanced pressure.

I fully agree with Mr. Stuart that there is no excuse for the heavy piston which until recently has been general practice in locomotive design. The remedy for this is the Z-type which is the lightest form for a given strength, weighing not much over two thirds that of the corresponding box type.

The use of a single packing ring would seem rather extreme but certainly three are not necessary and add useless weight.

Personally, I am unable to see much philosophy in the use of the piston rod extension and guide. The deflection of the rod may almost equal the clearance of 1/32 in. given the

piston and the wear of the shoe can hardly be maintained as near zero as would be necessary to make the arrangement efficient. The added reciprocating weight and extra set of packing are further objections.

HARRY S. BURNHAM.

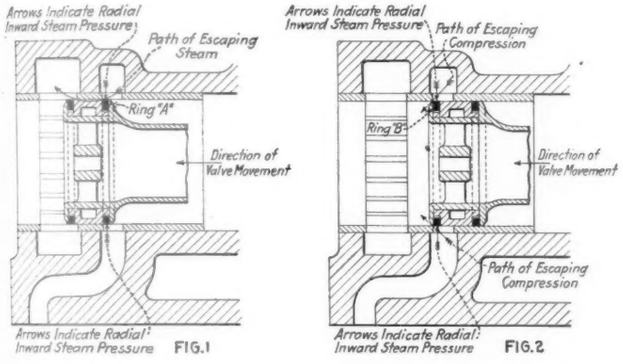
Some Defects of Piston Valve Designs

COUNCIL BLUFFS, Iowa

TO THE EDITOR:

The piston valve has been generally adopted for modern locomotives as it possesses a number of advantages over the flat slide valve. The most important of these are: a practically perfect balance of pressures, a larger port area with a reasonable size and weight of valve and a reduced cost of manufacture and maintenance. It is not our aim, however, to call attention to well-known advantages but to mention some of the less commonly recognized shortcomings of the inside admission type of piston valve as generally used.

The first defect is that of a large clearance space in ports


Arrows Indicate Radial Inward Steam Pressure
Path of Escaping Steam
Ring "A"
Direction of Valve Movement
Arrows Indicate Radial Inward Steam Pressure
FIG. 1
Arrows Indicate Radial Inward Steam Pressure
Path of Escaping Compression
Ring "B"
Direction of Valve Movement
Path of Escaping Compression
Arrows Indicate Radial Inward Steam Pressure
FIG. 2

Diagrams Showing Action of Steam Pressure on Packing Rings

and passages between the valve and the piston at the beginning of its stroke. This space must be filled with live steam at each working stroke and if unduly large is productive of a considerable waste of steam.

The piston valve, by reason of its cylindrical form, necessitates a comparatively large clearance space, for the ports in the bushing at the upper part of the circumference are at a considerable distance from the cylinder. Now it is true that these ports are of little value for the purpose of admitting steam, but are essential in attaining a balanced condition of the valve. They should therefore be reduced to the smallest size compatible with this result through at least the upper two-fifths of the circumference, and the remaining port space carefully proportioned so that the clearance space is kept at a minimum. The clearance space is, moreover, materially enlarged by an increase in the diameter of the valve, being approximately proportional to the square of the diameter. Undoubtedly there are valves in use on some freight locomotives which are larger than necessary. The diameter of the valve should always be kept down to the minimum.

Excessive clearance not only causes a waste of steam but also brings about a reduction of compression. In the present-day locomotive with often unduly heavy reciprocating parts, a considerable degree of compression is absolutely necessary to absorb the momentum of these parts. A proper amount of compression gradually takes up the slack in the rod connections so that when admission occurs a knock is avoided. Increased compression can be secured in two ways only: by reduction of the compression space or by securing earlier exhaust closure. As the limitations for applying the latter method are narrow, the possibilities for the former should be exhausted before the latter is tried.

High compression reduces the waste occasioned by excessive clearance. Indicator cards should therefore show a well-rounded compression curve if good results are to be secured.

Clearance may be reduced by making the ports short and direct, as by lengthening the steam chest until the port is straight and directly over the end of the cylinder. The necessity for a reverse curve in the port is thus eliminated and the center distance between steam chest and cylinder materially reduced. The increased space required in the exhaust port can be secured at the upper part of the steam chest.

The necessity for a large opening through the body of the piston valve is believed to be exaggerated. The size of this opening is governed by but one consideration, that is, the cross-sectional area of the space between the outer circumference of the spool and the inner circumference of the steam chest must in no case be less than the net area of the live steam port.

Let us now consider another defect in the piston valve, the consequences of which are of no less importance although the evidences are less apparent. Fig. 1 shows a longitudinal section of a portion of the valve, bushing and ports with the live steam packing ring *A* just passing off the inlet port onto the land between the ports. The ring is now subjected to radial inward pressure over practically its entire outer circumference. Opposed to this pressure is the more or less feeble resiliency of the ring itself and the possible pressure of steam which may have leaked under the ring. The external pressure is enough, however, to collapse the ring and permit the steam to flow past it between the bushing and the bull ring, which may or may not be a good fit in the bushing. Any steam so escaping passes freely to the exhaust port with little or no evidence of its escape. It is clear that well-fitted rings are more subject to this action than those which are loose in their grooves, as the steam cannot penetrate so freely under them and create a balanced condition.

Refer now to Fig. 2 in which the valve has moved to a position where the exhaust ring *B* is just closing the exhaust port and compression is beginning. Conditions are the same as before except that the exhaust ring is subjected to the lighter back pressure which, however, is still enough to compress the ring. The space through which the steam must escape is shorter than before and more open. Since compression takes place during a small part of the piston travel, it is apparent that the leak here need be but small to effect almost total loss of compression.

It is unquestionably true that a large part of the trouble with piston valve packing rings, particularly breakage, may be traced to the continual compressing and re-expanding of the rings. Lack of compression or the loss of it is also responsible for knocking and wear of rod connections, driving boxes, shoes and wedges.

What are the remedies? First, reduce the clearance to a minimum; second, make the rings so that they cannot collapse. Loss of live steam may be corrected by using three equally spaced rings on each end of the valve. This is only a partial cure, however, for it does not prevent the loss past the exhaust ring which affects the compression.

THOMAS E. STUART.

VERY VARIED VALUES.—Interesting examples of unusual sources from which scrap can be reclaimed are furnished by the practice of the Southern Pacific at its central reclamation plant. Sealing wax is obtained from worn-out dry cells; tin drinking cups and grease cans are made from coffee cans; scrap boiler tubes are threaded or welded and used for water drain lines, air lines and conduits; old shovel blades are made into washers; parlene, a by-product of Pintsch gas plants, is used for painting the underframes of cars; scrap rope is unwound and used for binding company shipments instead of twine; sediment from acetylene generators is used in place of lime for whitewashing and in the company's steel foundry.

THE QUESTION BOX

Design of Crank-Pin and Crank-Pin Hub

By A. Montangie
Civil Engineer, Belgian State Railways, Ghent, Belgium

This is in answer to the questions published on page 202 of the April issue.

The crank-pin of the overhung type is hydraulically pressed in the hub. This practice entails the following assumptions:

1—The bore of the hub is one or two per cent smaller than diameter of pin, say bore = 99 per cent of diameter of pin.

2—Conicity of bore $= \frac{1}{100}$

a—Fibre stress in hub due to the pressing of the crank-pin.

In Fig. 1, with conicity purposely exaggerated, the force, F, gives on a lateral section, s, a pressure, N, of which

K, the radial component = N cos a

K′, the tangential component = N sin a; a = 35′.

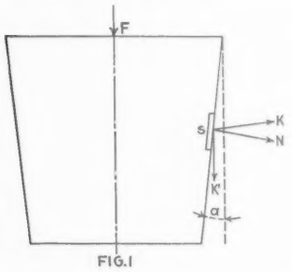


FIG. 1

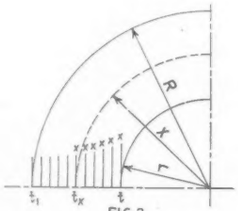


FIG. 2

K = 0.99996 N; K′ = 0.0102 N. Practically we take no account of the downward thrust K′, and assume K = N. The total thrust, F, is frictionally absorbed by the hub. Hence

(1) $F = \pi DLN$ F = 140 tons (short tons of 2,000 lb.)

D″ = 7 in.

L = 7½ in.

N = 0.85 tons per sq. in.

To determine the fibre stress in the hub, we use Lame's formula giving the tensile stress t_x for layer X (see Fig. 2).

$$(2)\quad t = \frac{(p - p')\,R^2 r^2}{(R^2 - r^2)\,x^2} + \frac{pr^2 - p'R^2}{R^2 - r^2}$$

p = N = 0.85 tons per sq. in.; p′ (outside pressure) = 0

Maximum tensile stress occurs for minimum of X, therefore X = r

$$T = N\,\frac{R^2 + r^2}{R^2 - r^2} = 1.61 \text{ tons per sq. in.}$$

R = 6¾ in., r = 3¾ in.

Minimum tensile stress for x = R; t_1 = 0.76 tons per sq. in.

The t_x curve is a hyperbola (third degree) Marked xx..

b—Maximum allowable pressure.

Taking the tensile strength of cast steel, 90,000 lb. = 45 tons

the safe working load = 75,000 lb. = 7½ tons.

Formula (2) with t = 7½ gives N = 3.96 tons per sq. in., which is the maximum pressure

3.96 × 165 = 650 tons.

d—Strength of pin to resist load W

(1) Load W Assumptions:

Boiler pressure 180 lb. per sq. in.

Steam chest pressure 160 lb. per sq. in. = p

Back pressure 20 lb. per sq. in. = p′

$$\frac{\text{Throw of crank}}{\text{Length of connecting rod}} = \frac{r}{l} = \frac{1}{5} \text{ (see Fig. 3)}$$

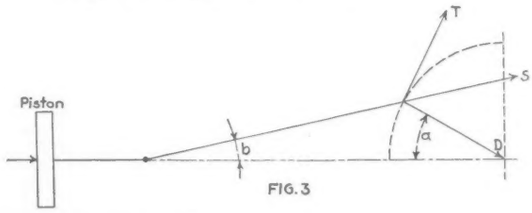


FIG. 3

P = pressure on piston

S = thrust on connecting rod = P ÷ cos b

T = tangential pressure or turning moment = S sin (a + b)

D = radial pressure = S cos (a + b)

Maximum of S for a = 90 deg. $= \frac{P}{\sqrt{1 - \left(\frac{r}{e}\right)^2}} = 1.02\ P = S_{max}$

Maximum of T for a + b = 90 deg. Since $\frac{r}{l} = \sin b = \frac{1}{5}$

b = 11 deg. 30′ cos b = 0.980 $T_{max} = P \div 0.98 = 1.02\,P$.

Maximum of D for a b = 0° or a = b = 0: P = D

The maximum of W is $\frac{\pi D^2}{4}(p - p')\frac{1}{\cos b} = 1.02\ P = 70{,}000$ lb. or 35 tons

2—Strength of pin

(3) Bending moment $M = W\frac{l}{2} = \frac{I}{e}K = 0.1d^3K$ with { K = 7½ tons per sq. in., l = 7½ in., W = 35 tons }

$$d = \sqrt[3]{\frac{\frac{W\,l}{2}}{0.1\,K}} = 5.59 \text{ in.}$$

To insure efficient lubrication the unit pressure should not exceed a certain value k′, a complex function of the speed in r.p.m., the metal in contact, oil, etc.; k′ is empirical or determined by experiment

W = KLD; for D = 6½ in., L = 7½ in., k′ = 0.74. For hard steel pin running or bronze bearings and a speed of 150 r.p.m. the usual figure is taken between 0.4 and 0.6 tons per sq. in. In the present case lubrication to be efficient shall be abundant, or an oil of high viscosity shall be necessary.

3—Stress in hub due to the load W and pressure of pin.

Maximum bending movement M = W × m = 340 tons
Maximum shearing force T = W = 35 tons } in section AA′

The reaction of the cantilever in the hub may be likened to two compressive forces R_1 and R_2 acting at ¼ and ¾ l from section AA′ in a diametral plane of the pin containing W.

We have $W + R_2 - R_1 = 0$

$M + \frac{WL}{4} - \frac{L}{2}R_2 = 0$

giving $R_1 = \frac{M}{0.5\,L} + 1.5\,W = 150$ tons

$R_2 = \frac{M}{0.5\,L} + 0.5\,W = 150$ tons

The lower half ring ABo'o is compressed by

$$\frac{R_1}{\frac{1}{4}\pi DL} = 3.64 \text{ tons per sq. in.}$$

Total maximum stress in this ring 3.64 + 1.61 = 5.25 tons per sq. in. In the lower half ring Bo'o" c we have

Compression stress in hub = 1.61 tons per sq. in.

$$\text{Tensile stress } \frac{115}{\frac{1}{4}\pi DL} = 2.8 \text{ tons per sq. in.}$$

$$-1.19$$

or a negative stress, which means that the tension due to W

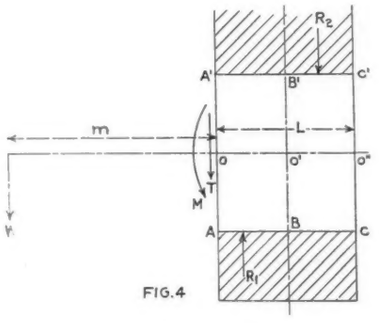


FIG. 4

relieves the hub of the compression stress due to the pin. For the upper half rings we have

A'B'o'o, — 2.03 tons per sq. in. no compression on hub
B'c'o"o' + 4.41 tons per sq. in. compression

The present crank-pin is provided with a sufficient margin of safety. Mention has to be made that figures are according to European practice, the specifications of the A.R.A. not being at hand. If any marked differences occur, corrections are to be made accordingly.

AIR BRAKE CORNER

How Would You Answer These Questions?

Questions.—1. How could a train be handled if the brake pipe was broken behind the connection leading to the automatic brake valve in either A1 or ET equipment?

2. If the automatic brake would not apply but the independent brake functioned properly, where would the trouble be?

3. If the automatic brake would not apply on a long train but operated correctly when the engine was detached from the train, where would you look for the trouble?

4. If, when applying the brake with either brake valve—the engine being equipped with the ET brake—the main reservoir pressure began to fall, where would you look for the trouble and what should be done to avoid stalling?

5. On an engine equipped with the ET brake, if the feed valve pipe was broken between the feed valve and the brake valve, what should be done?

(The questions given above were sent to us by a subscriber in West Grand Forks, British Columbia, Canada. Similar questions have doubtless been asked and have been discussed more than once by enginemen and air brake men in roundhouse gatherings or in instruction cars. They are of the kind that make a man think. Send us your answers. As an additional incentive to do so, we will print the best replies and send the one who wrote them a check for $10.—(*Editor.*)

Hearing on Power Brakes by Interstate Commerce Commission

IN conformity to order No. 13528 of the Interstate Commerce Commission, dated February 20, 1922, and supplementary orders in connection therewith, an important hearing in regard to power brakes and appliances for operating power brake systems was started in Washington on Wednesday, May 17. The object of the inquiry and investigation is to determine whether, and to what extent, such brakes and appliances now generally in use on locomotives and cars are adequate and in accordance with requirements of safety, what improved appliances or devices are available for use, and what improvements may or should be made to obtain increased safety in train operation.

The hearing is being held before Examiner Mullen. The air brake manufacturers and the American Railway Association are represented by counsel and on account of the importance of the case the sessions are being attended by from 80 to 100 men, among whom are most of the air brake supervisors of the largest railroad systems.

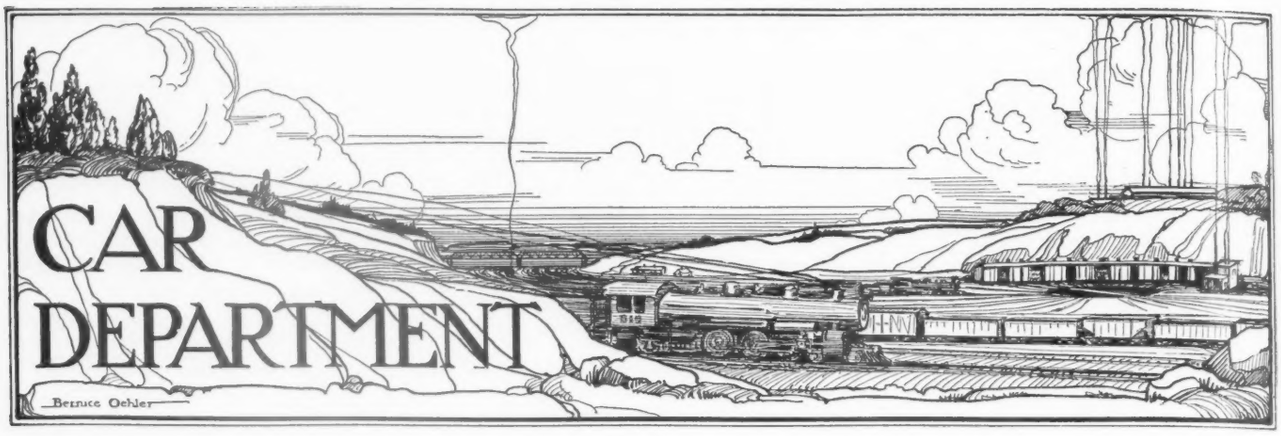
The first subject taken up was the air brake apparatus which has been developed by the Automatic Straight Air Brake Company, New York. In substantiation of their claims for the need of such a system and that it was superior to the Westinghouse air brake system now in general use, Clark and La Roe, counsel for the Automatic Straight Air Brake Company, have called a number of witnesses and submitted many exhibits. The first witness examined was Robert Burgess, southeastern manager of the Westinghouse Air Brake Company. The questions centered around a paper presented by Mr. Burgess before the Southern and Southwestern Railway Club in November, 1919, relative to the empty and load brakes. The next witness examined was S. D. Hutchins of the Westinghouse Air Brake Company, who was questioned in regard to a memorandum relative to the automatic straight air brake which he sent to M. A. Kinney, superintendent of motive power, Hocking Valley. Mr. Hutchins was followed by W. S. Bartholemew, vice-president, Westinghouse Air Brake Company, who was questioned in regard to a similar general memorandum.

The next witness called was M. E. Hamilton, field engineer, Automatic Straight Air Brake Company. His testimony covered the operation of the automatic straight air brake both in solid trains and when mixed with Westinghouse brakes, as observed on the test rack and on various railroads where this system has been applied. Evidence showed that an early design of the brake was tested on the Virginian in 1918 and subsequently removed. The apparatus of this company is now in service on the following equipment: 100 coal cars on the Norfolk & Western; 40 coal cars on the Denver & Salt Lake; 11 passenger cars on the Chicago & Eastern Illinois; 48 passenger cars on the Erie, and 6 passenger cars on the New York Central. Additional orders now on the books include brakes for the New York, Chicago & St. Louis; Pere Marquette; Rock Island; Erie; Norfolk & Western; Missouri, Kansas & Texas; and El Paso & Southwestern.

A number of enginemen and brakemen of various roads who have operated trains on which automatic straight air brakes were in use have been called to testify as to the operative results obtained.

From present indications it appears that the hearing will be thorough and will last for some time, as many additional witnesses are to be called. These will include additional witnesses for the Automatic Straight Air Brake Company, also witnesses for the Westinghouse Air Brake Company and probably others for the railroads or called by the Safety Bureau of the Interstate Commerce Commission.

The above covers the evidence presented during the first week. Further details will be given in the next issue.



The Design of Passenger Car Repair Shops

Requirements for Various Departments Outlined and Typical Layouts Proposed by A.R.E.A. Committee

At the 1922 convention of the American Railway Engineering Association, the Committee on Shops and Locomotive Terminals presented a report on the design of car shops prepared by a sub-committee, of which L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul, was chairman, the other members being Walter Goldstraw, E. M. Haas, L. L. Tallyn, and A. M. Zabriskie. This report includes much valuable information not only from the standpoint of new shop layouts, but also suggestions for the operation of existing shops. On account of its general interest, it is reproduced in part below:

So many passenger car repair shops throughout the country today have a fifty-year-old nucleus, with piece-meal additions, in which the shopmen are making the most of what their shops possess, and are struggling along as best they can to keep modern equipment in repair and serviceable, that it seems proper that careful study and consideration be given to the subject of repair shops, with the view of improving facilities and developing plants that are as modern as the equipment to be maintained. If each workman in a shop, where 1,000 men are employed, saved five cents for the railroad company each day, the sum saved in one year, of 300 working days, would amount to $15,000, an amount which is equivalent to five per cent interest on a capital of $300,000. Yet in most, if not all, railroad shops it is indeed conservative to estimate that each man wastes five cents' worth of his time daily due to poor shop layouts, poor arrangement of facilities, antiquated tools and machinery, or old-fashioned methods of handling work, conditions over which neither he nor his immediate supervisors have any control.

Dispatching Repairs

Harrington Emerson in his book, "The Twelve Principles of Efficiency," says "The railroad that dispatches its 'crack' trains with ninety-nine per cent of time accuracy has either no dispatch system or a very crude one for work, either big or small, through its shop; therefore, in some cases it fails to realize an efficiency of even one per cent, and on the big average of all shop work fails to realize either a time or cost efficiency of more than forty per cent. . . .

"It is interesting to note in the matter of repairs the great superiority of marine repair dispatching over locomotive repair dispatching. A vessel will be put in dry dock . . ., and be completely scrapped, repainted, new propeller and rudder fitted, new plates inserted in perhaps three days. . . .

"A fifteen-day schedule for general repairs to a locomotive is considered fast time and the average is nearly thirty, but if the time for each item is separately entered in the summary, it is hard to discover why three days would not be enough."

Considering the importance of these facts, this report is written with an object to obtaining high efficiency fully as much as to gain mechanical excellence. However, the two are co-ordinate, for high efficiency bears with it mechanical perfection.

In laying out a passenger car shop, or any other, no better advice can be given than that offered by Herbert Kaufmann, when he said, "Make your chart before you start. Know what you're after before you start out for it."

Importance of Proper Layout

The committee in submitting this report has endeavored to cover only what seems to be best in layouts and treat the subject so that it will be of most assistance to the greatest number. Most railroad shops of today are operated on the hourly basis, and it is therefore on arrangement, organization and supervision that efficiency, output and workmanship depend. Furthermore, when it is remembered that organization and supervision are in a large measure dependent on layout of plant and facilities the importance of the first factor is appreciated.

The shop, yards, buildings, and machinery should be arranged so that the various operations follow through in a logical sequence; the bad order equipment should pass in at one point, progress by various steps, without hindrance, or delay from congestion or awkward movements, over a predetermined circuit to the point of release and emerge as a finished product. In general repair work, a car will enter the shop, be unwheeled and stripped, after which the car, trucks and trimmings will progress through the shops, each over a different route, and will finally meet at some point for trimming, assembly and release.

The older shops are generally situated within the limits of some city, with the result that now the cities have grown around them, hemming them in and forbidding their further development. It is hopeless to attempt the development of a modern plant in cramped quarters. Therefore, a location must be sought elsewhere even though the shop crews are well established and the labor conditions favorable at the old point, but in the selection of the new site, while it may

be true that labor will follow the job, the importance of selecting a location with a suitable labor market must not be neglected.

Local Conditions to Be Considered

Topographic and climatic conditions must not be lost sight of, and in laying out a plant, nature must not be forgotten. A careful study of the forces of nature must be made so as to offset or reduce any hindrance from this source and at the same time secure any benefits that may be derived. Too often, in order to take advantage of cheap real estate, ease and simplicity in providing drainage and other things, shops are located in valleys adjacent to water courses which cannot be controlled, with the consequence of much damage from floods and severe losses from delay and interruptions to operations, the cost of which offsets the savings in first cost many times over.

It is useless to attempt, in an ideal layout, to fix definite dimensions and proportions. These must be left to be determined for each particular case from the policies, practices, and conditions prevailing. It is the policy with some railroads to thoroughly overhaul the trucks of every car passing through the shops; therefore, for them an elaborate truck repair shop is required. At other shops a large portion, or all of the equipment may be steel cars requiring extensive steel working machinery and but small wood mill equipment. Roads not operating their own sleeping cars do not require the space for upholstery work demanded by those that do. Where the climate is mild a great deal of work may be done out of doors, and so there are a great many factors to be considered. It is our object to offer something that can be used as a guide. The committee's submission, therefore, is laid out so that all operations can be taken care of indoors and those using it as a guide need subtract rather than extend.

All buildings should be substantially built, of fireproof construction, well lighted, comfortably heated, and have good ventilation. The last three requirements, together with large sanitary lockers, wash and toilet rooms, go a long way in keeping up the morale of the employees and will produce returns on investment in the form of efficiency, quality and quantity of the work produced.

For the passenger car work, buildings with transverse tracks served by transfer tables undoubtedly give the best operation. Passenger coaches, which are handled singly, can be placed or shifted about much more expeditiously and with better provision in a transverse layout than in any other. Frequently, the transportation department requests that preference be given certain cars after they have been placed in the shops, making it necessary to shift their position. The plant should, therefore, be flexible for the moving of individual cars. On the other hand, the reverse is true of freight car shops. Freight cars are handled in groups; therefore, a better operation is to be had from a longitudinal layout.

The committee makes the following general comments and recommendations for the various subdivisions which make up a large passenger shop layout.

Coach Paint Shop

The paint shop should be of fireproof construction, light, airy, roomy, free from dirt and dust, and should be well heated in cold weather. The most economical operation as to first cost and production is obtained with a building of sufficient width to hold two cars on each transverse track with ample aisle room on either side and in the middle. With more than two cars per track awkward conditions arise in moving the center car. Each track should run through and be served by a transfer table on either side of the building. The tracks should be 25 ft. from center to center. The floor should be concrete and should pitch to floor drains to allow for scrubbings and quick drying after.

Traveling cranes and supply tracks are not needed. Permanent scaffolds should be provided. They should be adjustable and easily operated, preferably suspended from overhead so they can be pushed up out of the way when not in use. Ample space should be allotted for storing and mixing paints. This should be located at the center of the building for so large a plant as this, so as to be equally accessible from the extreme ends of the shop. Ample toilets, wash and locker rooms should be provided.

Some places may require baking ovens, in which case they may be provided for across the transfer table or a few stalls of the paint shop may be converted for this purpose.

Coach Repair Shop

The same width and track arrangement is recommended as for the paint shop. The building should be divided into two main bays, one on either side with a center aisle about twenty feet wide in which should be installed a fifteen-ton traveling crane. This should be operated from the floor so that the operator can hook on his own loads or do other tasks at such times as the crane is not in use.

The floor should be wood block, substantially constructed to withstand the severe wear from the handling of heavy parts. Permanent scaffolds should be provided of the same construction as recommended for the paint shop. The shop should be piped for compressed air, steam, water, and acetylene, and ample electric connections should be provided.

If cars are all placed on dollies before they are taken to the repair shop, pits are not necessary. However, as the probabilities are that not all cars will be unwheeled, a portion of the stalls should be provided with pits.

Some tools and machinery are necessary in connection with this shop, although it may be the intentions to do the greater portion of the work in the main machine and blacksmith shop; therefore, a certain space should be set aside for this purpose. The pipe shop, air room, and tin shop should be annexed to this building, if possible, as the greater portion of that work comes from and goes back to the cars while in this shop.

As with the paint shop, the best operation will develop from this shop being served on both sides by a transfer table.

Wash House

At most shops the cars are washed on the same track on which they are painted, or on tracks in the paint shop especially set aside for this purpose. At some places the washing and stripping is done on the same tracks. In view of the continual dampness resulting and the hindrance which it produces on the paint work, the committee recommends that a separate department be assigned and be properly equipped for this work. Certain stripping such as the removal of air equipment can be advantageously taken off here.

The wash house should be well lighted, heated and ventilated so the cars will dry quickly. It should have a concrete floor, properly pitched, with frequent floor drains to give good drainage. Gutters in the floor between tracks or so located as to catch the drip from the sides of the car will greatly assist in keeping the floor dry. Scaffolds should also be provided and the shop should have water and steam connections. Floor space should be provided in a convenient location for the preparation of soap and acid solutions.

Stripping and Trimming Shop

A very logical and economical grouping of operations can be accomplished by providing a place for stripping cars of sash, doors, upholstery, and fixtures as they pass into the shops and another for trimming them as they go out with space in between where the parts removed can be repaired, finished, and stored ready to be placed back on the car as it goes out. It is the custom at most shops to remove such things either in the yard, paint or repair shop, haul it to the respective departments for repairs, painting, plating, etc.,

and then haul it back again to paint shop, yard, or some other place where the car is trimmed, all of which involves considerable labor and forms a serious problem in the shop operation. Therefore, the committee recommends the adoption of an arrangement as just described and as indicated in the proposed layout for large plants of this kind, where the trim may be removed, pass through its respective department, while the car is progressing through the shop, be stored, finished, and ready for the car after it has passed the paint shop and has been brought back to the trim shop on its way out.

Unwheeling Hoist

The manner of removing trucks from under the coaches varies greatly with different shops. At some shops the car is taken directly to paint shop where the trucks are removed and the body set on horses. The trucks are then taken to the truck shop or machine shop. In some places the trucks are overhauled at one end of the coach repair shop or paint shop, while at others they are taken to a separate shop. At some shops the cars are jacked up in the yards, the bodies put on dollies and the trucks and bodies wheeled to the respective places for repairs.

A much smoother operation is to be had from the practice of placing the bodies on dollies, providing the course through the shops is smooth and systematic. The unwheeling if done by a permanent or fixed hoist can be accomplished more expeditiously and with less hazard to employees than by the use of the ordinary jacks. With a layout of this size the labor saved will more than justify the expense involved. The use of dollies not only affords an easier and more simple way of handling the bodies but in case of fire offers a chance of saving some cars which would be impossible if resting on horses.

In the layout herewith submitted, two traveling cranes, one located in the stripping shop and the other in the trimming shop, are suggested for this purpose. These cranes should be at least of 80-ton capacity and have two hoisting drums, one for either end of the car body.

Truck Shop

In most shops the trucks are repaired on the same tracks with the cars, or on a few designated tracks in the passenger car repair shop. A separate truck shop gives better supervision, more production and permits a better and more extensive use of the proper tools. A separate shop permits the segregation of material, tools, and facilities such as hoists, lye vats, spring testing machines, truck gauges, and templates. The shop tracks should be transverse with room on each track for two sets of trucks. The building should have two main bays on either side and a narrow bay at the center with a ten-ton traveling crane. A longitudinal track should run the full length of the building to facilitate the handling of mounted wheels and axles.

Over each track in the side bays should be installed a five-ton floor-controlled traveling crane for the handling of truck parts, and the removing and replacing of wheels.

There should be ample track space outside for the storing of trucks, ready for and after leaving the truck shop. The truck shop should be located close to the smith, machine and wheel shops. The shop should be well lighted, heated and ventilated. Concrete or wood block is satisfactory for floor.

Wheel and Axle Shop

This shop should be conveniently located to both the freight and passenger repair shops. Large yard space is necessary in connection with this department for the storage of wheels and axles, both mounted and unmounted. Free movement of this operation is essential to economical production, and great care should be exercised in laying it out. Monorails form the best method for serving this shop. These should extend out into the yard for the handling of the

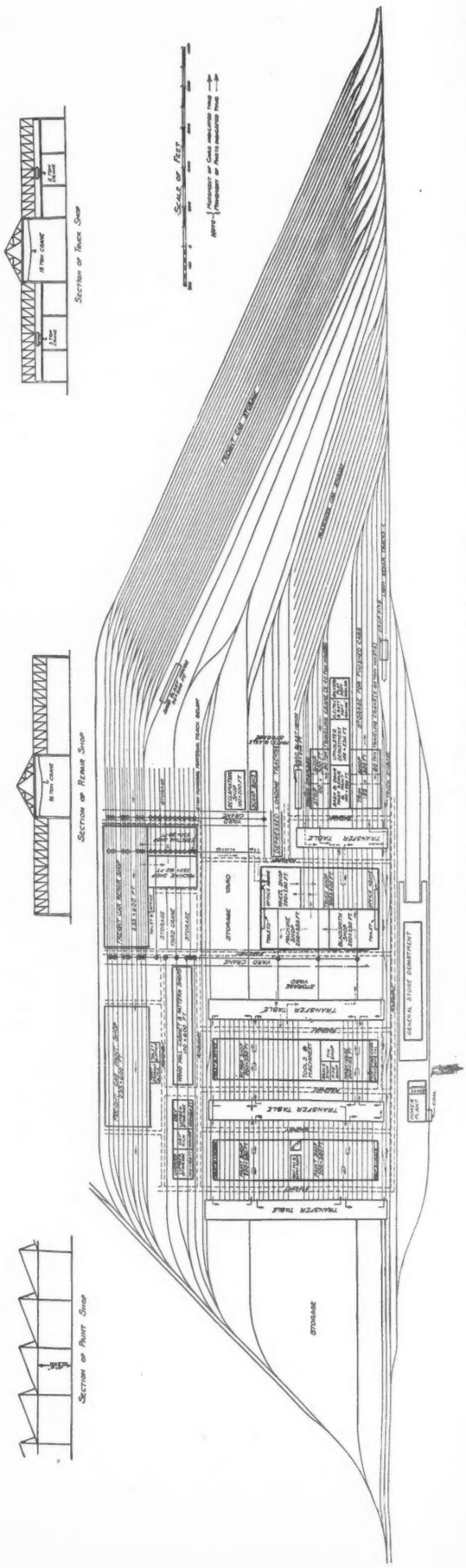


Fig. 1—Proposed Arrangement for a Passenger Car Repair Shop

wheels and axles both into and out of the machine shop.

The building should be well lighted, heated and ventilated, and the floor should be substantially constructed, preferably of wood block.

Blacksmith and Machine Shop

These two shops are treated together because most of the work progresses through the smith shop into the machine shop to be finished. They should be very conveniently located with respect to the truck shop and easily accessible for the coach repair shop, as these two departments furnish practically all the work.

These shops should be well lighted, heated and ventilated. Particular attention should be paid to ventilation in the smith shop. Wood block floor is preferable for the machine shop, while a good solid dirt floor gives best results for the smith shop.

Yard cranes and push cars are necessary for handling material to and from the shops, and monorails, jibs, etc., should be amply provided for handling the work inside the building.

Wood Mill, Pattern and Cabinet Shops

These three sections are closely related. All do wood work, and in the majority of layouts are combined under one roof and it is proper that they are. The mill should be conveniently located with respect to both passenger and freight car repair shops and should be so placed that ample yard and storage space is available for the storing of lumber. It should have as an accessory a dry kiln and large sheds for the storing of dried lumber.

At least two supply tracks, leading from yards and sheds, should be run longitudinally through the mill and the machines so spaced that heavy timbers can be easily handled from cars to machines and progress through the mill in logical sequence, leaving the mill at the opposite end from yard in a finished state.

The building should have good light, heat and ventilation and should be of fireproof construction. Some means of disposing of sawdust and shavings must be provided. The preferable means of disposal is to bale for a commercial trade. There is now a good demand for shavings as a substitute for straw in packing crockery, etc. This is preferable to burning them in boilers as they are not satisfactory fuel and in addition require special boiler settings and provisions for handling.

If many patterns are to be made and stored, a separate fireproof storage should be provided.

Power Plant

This involves a study in itself, for a great deal can be done toward economy in the selection and proper installation of boilers and appurtenances, together with the proper coal and ash handling equipment. The power plant should be made ample for all requirements, spare units should be installed to insure continuity of service and to allow for the making of routine repairs.

The water, steam, air and electric power systems for a layout of this kind are worthy of very careful study and consideration.

Miscellaneous

(a) Foundry—Unless there is to be a separate foundry run independently to serve all departments, it is well to have a small brass foundry in connection with the Car Department.

(b) Sand Blast House—This because of the dust and dirt produced should be isolated somewhat from the other department, but should not be too far away to cause delay in detouring from the main circuit.

(c) Reclamation Department—Should be centrally located with respect to freight and passenger car repair and machine shops and in the vicinity of the scrap yard.

(d) A fire department, hospital, and ambulance is quite essential with a plant of this size.

(e) All transfer tables should be of ample dimensions and capacity to allow for rapid travel and expeditious handling of cars.

(f) Paved roadways and walks of ample width should be provided throughout the plant to afford ease of communication, facilitate trucking and allow unobstructed passage for both the fire-fighting equipment and for the ambulance.

From the standpoint of economy in layout and subsequent operation, the grouping of as many departments as can be consistenly united into one large plant is recommended. Between the locomotive and car departments the storehouse and its supply yards, the power plant, water, heat and light systems, the fire department, hospital and ambulance service, and the general office can be used in common at a lower initial cost outlay than would be necessary to fit up two independent plants. The relation between the passenger car and freight car departments is even closer. The wood mill, the machine, blacksmith, and wheel shops can handle work for either equally well. The supplies, stores, power plant, etc., can serve both and the extra land, buildings, and machinery necessary to fit out two separate plants would more than offset any advantages that may be derived from separate operations.

In preparing the layout submitted with this report (see Fig. 1) it was assumed that the topography was favorable and that ample property was available. It is considered that the plant as shown is to form a part of a complete repair point for the maintenance of both cars and locomotives; therefore, the power house and store department will be common and should form the natural separation between the two departments. In sizes, the intention is that it be sufficiently extensive to take care of most any large point. No provision for extension has been indicated, but the suggestion is that if only a portion be used the remaining space be allotted for this purpose, or if built full size that additional space transversely be provided.

The actual capacity of the plant as laid out will depend to a great extent on the average painting schedule. The paint shop will hold sixty cars, and if worked on an eight-day schedule, should permit of a capacity of eight cars per day. This operation is really the criterion, and if other departments are properly proportioned, will control the output of the entire plant.

Thus unimpaired by cramped quarters, it is the intention to execute a layout which will give freedom to productive movement of cars through the shops, eliminate all unnecessary handling of materials and parts and locate the various operations and groups logically and with due regard to their relation to each other.

The routing through the shop forms a complete circuit. The cars to be repaired are delivered to the receiving yard from which place they are switched, as selected, to the tracks leading into the stripping shop. Inside this building brake rods, etc., are disconnected and removed and the car moved up under the crane where the body is removed from the trucks, set on to dollies, and the trucks switched out. The outside track should be used for the handling of trucks, from which they can either be moved via the transfer table or shifted in the opposite direction and placed on storage tracks. Before leaving the stripping shop all the sash, doors, hardware, upholstery, fixtures, etc., are removed and delivered to the proper quarters for repairs.

From this building the car body is moved via transfer tables and tracks, first to the washing shed, then to the coach repair shop and from thence to the paint shop. After the car has been painted it is brought back via transfer tables and tracks to the trimming shop, trimmed, mounted onto its trucks, leveled, brake rods hooked up, and put onto the outgoing tracks for release.

The trucks are removed from the storage tracks, to which

Fig. 1—Proposed Arrangement for a Passenger Car Repair Shop

they were shifted after the bodies were taken off, via transfer table to the truck shop for repairs, after which they are placed on the storage tracks adjacent to the trim shop to await the arrival of the bodies.

The wheel shop is at one end of truck shop and the smith and machine shop is alongside of it. As the heaviest work contributed to each of these three shops originates in the truck shop, this forms a logical grouping. The coach repair shop located just across the transfer table from the smith and machine shops with the mill just above it forms another convenient grouping.

Between the stripping and trimming shops are located facilities for handling sash, doors, upholstery, fixtures and hardware. Thus the handling of these parts is reduced to a minimum.

The paint shop which is practically independent from the rest of the layout is at the extreme end.

Between the wash house and repair shop is space allowed for air equipment, pipe work, tin shop, and for tools, and such small machines as will be necessary for this department, it being considered that the heavy smith and machine work will be done in the main building.

At the lower end of the wash house is space for the fire department, ambulance, and hospital. This is a convenient point and gives them a central location.

For such cars as are required to have paint burned off and sand blasted a separate building is provided just above the stripping shed. The dust arising from this prompts its being isolated; this location while taking care of this feature does not break up the free movement, as the car after being stripped can be moved via transfer table to sand blast house and thence to repair or paint shop. The back up movement is not a serious obstacle in this case as a small percentage of the cars are burned and sanded.

There is ample space and track facilities around the wheel shop for the storage of wheels and axles both mounted or unmounted. The wheel shop is conveniently located with relation to the passenger car truck shop and to the freight car repair plant.

The smith and machine shops are primarily to handle passenger car work only. Ample storage space has been provided for material both raw and finished between the building and the transfer table and between the machine shop and freight car department. Yard cranes are indicated which will greatly facilitate the handling. Standard gauge tracks over which push cars can operate will further assist in this respect. The close grouping of machine, smith, truck and wheel shops will provide for easy supervision forming one very economical feature.

It has been the intention throughout to eliminate all small buildings or sheds. Such structures not only form the nucleus for the addition of other sheds as the plant expands, but bring about a bad operation in supervision and produce excess handling of materials and parts.

It is the committee's recommendation that space inside the main buildings be set aside for toilets, locker rooms, and offices, and thus avoid all leantos and unsymmetrical additions. Toilet and locker rooms can be installed on main floors with offices above very advantageously. An elevated office is desirable as it gives isolation and a good means of supervision.

The reclamation shop has beeen located between the machine shop and the freight car repair shop. This is both a logical and convenient point as parts to be reclaimed will be received from both plants. The scrap bin should also be placed in this vicinity.

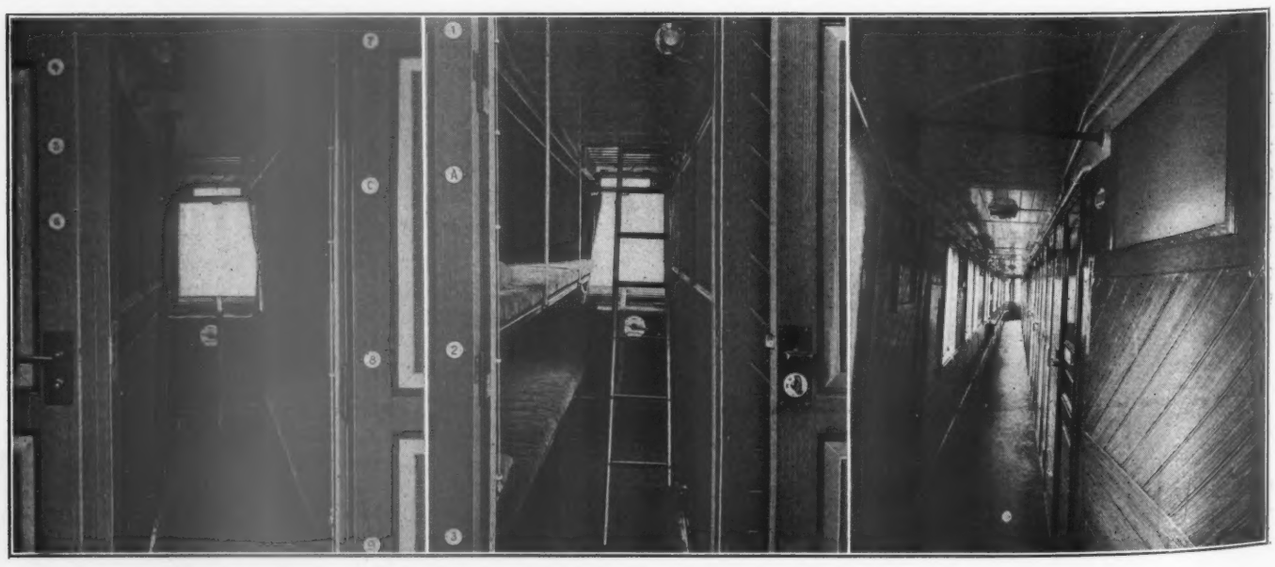
The wood mill, cabinet and pattern shop are logically located between the coach repair and the freight car repair shops, providing free movement for material to either place. The lumber storage is below the coach paint shop and also adjacent to the mill. It is considered that the layout is equally accessible from either end for switching in cars of material.

A "rip" track with drop pit is also suggested, for light work on cars not required to pass through the shop. This has been located near the receiving yard.

Above the passenger car shop a layout has been prepared for a freight car repair plant of considerable size.

Third Class Sleeping Cars for German State Railways

EUROPEAN travelers in the United States often criticize American Pullman cars because of the lack of privacy accorded the passengers. To Americans, however, the European compartment sleeper, with the berths extending transversely across the car and compartments in which the passenger faces a blank wall, are likewise unsatisfactory. Probably no more striking contrast between American and European equipment could be found than the modern American Pullman car as compared with the third class sleeping cars recently built for the German State Railways by the Linke-Hofmann Works of Breslau, Germany.



Interior of German Sleeping Cars; Compartments Arranged for Sitting and Lying; Looking Down the Side Aisle

In size, the cars are comparable with American rolling stock, the length over the buffers being 70 ft. 4 in. and the width, 9 ft. 5 in. The underframe is of steel and the exterior walls of the body are of steel plate, three millimeters (approximately 1/8 in.) thick. The floor is made of two layers of boards and the interior partitions are of wood.

German Third Class Sleeping Car

The ends of the car are made torpedo-shaped to afford an easy entrance to the car without the use of a vestibule end. The interior is divided into twelve compartments, each having seats and berths for three passengers. There is also a porter's compartment, two toilets and two washrooms. The side passageway is 30 in. wide and extends directly from one end of the car to the other.

Each compartment is 6 ft. 3½ in. by 4 ft. ½ in. There are three berths, 24½ in. wide, placed one above the other. The top and bottom berths are stationary and the center berth is pivoted. During the day the lower berth is used as a seat and the center berth drops to form the back. At night the center berth is held up by fastenings in the wall. Two straps suspended from the ceiling keep the passengers in the upper berths from falling out. The berths have plush upholstery and horsehair stuffing; apparently no springs are provided. Access to the upper berth is gained by a ladder which is swung over against the side of the compartment during the day. The cars are lighted by electricity from a generator mounted on the truck.

The truck construction, as will be noted from the exterior view of the car, is similar to American practice. The trucks have spiral and elliptic springs and equalizers suspended from the journal boxes. Compressed air brakes are used, as is now the standard practice in Germany, with the one brake cylinder for both trucks.

New Features in Service Railway Motor Coach

Unique Type of Truck with Cushioned Wheels— High Seating Capacity Combined with Light Weight

A MOTOR coach especially designed to meet the requirements of railway service has been built by the Service Motor Truck Company, Wabash, Indiana, and is now being operated on demonstration trips over the lines of the Big Four between Wabash, Indiana, and Benton Harbor, Michigan. The power plant and details of the transmission follow regular motor truck practice, but the design of the running gear as well as of the car body is a complete departure from the motor bus type of construction. A seating capacity of 38 passengers is provided in the body of the car and there are seats for 8 additional passengers in the baggage compartment, which may be folded up against the sides of the car.

The Model 55 Service Coach Drives on All Four Wheels of the Leading Truck

Although the total weight of the car does not exceed 13 tons the body is of rugged construction built up on an underframe of four 6-in., 8-lb. channels and it is carried on two four-wheel trucks with power transmitted to both axles of the forward truck. The body is 42 ft. 5 in. long over the bumpers and 8 ft. 6 in. wide over the posts. The frame is of steel construction throughout and is finished on the outside with steel sheeting. The engine hood, with the exception of the radiator is included in the baggage compartment, which is 8 ft. long back of the hood, and is served by a sliding door on either side. The passenger compartment is entered through a vestibule at the rear end of the car which is fitted with trap and side doors in accordance with steam railroad practice. Each window has two sashes, the lower one of which can be raised, and is fitted with a Pantasote curtain. Suction ventilators are also provided in the roof. A saloon with a dry hopper and an alcove water cooler is located in the forward left hand corner of the passenger compartment. The car is heated by exhaust gases from the engine carried back through the passenger compartment in thin wall steel tubes, one on either side. The body was built by the J. G. Brill Co., Philadelphia, Pa.

The power plant is a four cylinder, four cycle, valve in head motor with 4½-in. by 6-in. cylinders. This motor has a safe constant operating speed of 1,500 rev. per min. at which it has a rating of 61 hp.; its maximum speed is 1,800 rev. per min. at which it has a power rating of 66 hp. The clutch and transmission are mounted in a unit with the engine and provide three speeds with gear ratios of 4.09 to 1, 1.76 to 1, and 1 to 1. The power plant is mounted between the channel sills at the front of the car and is removable as a unit. The fuel tank has a capacity of 50 gals.

Power is transmitted from the main transmission through an auxiliary transmission mounted in the cast steel swinging bolster of the forward truck, by means of a motor truck type propeller shaft having two universal joints. The auxiliary transmission provides two gear ratios for forward operation, one for 30 miles an hour maximum speed and the other for 40 miles an hour maximum speed. One ratio is provided in reverse, designed to give a maximum speed of 30 miles an hour. This makes a total of six speeds forward and three in reverse. From each end of the auxiliary transmission a motor truck propeller shaft provided with two universal joints transmits the power through a pinion and bevel gear drive to one of the axles of the forward truck.

The most unique feature of this car is the type of truck construction used. The trucks are of the four-wheel type, the axles having inside bearings of the Timken roller type. The truck frames are built up of 6-in. I-beam side rails on which are placed the channel cross members that carry the swing motion bolster. The ends of the side rails are also joined by cross channels with gusset plate connections. The axles are of alloy steel, heat treated and are 3 in. in diameter.

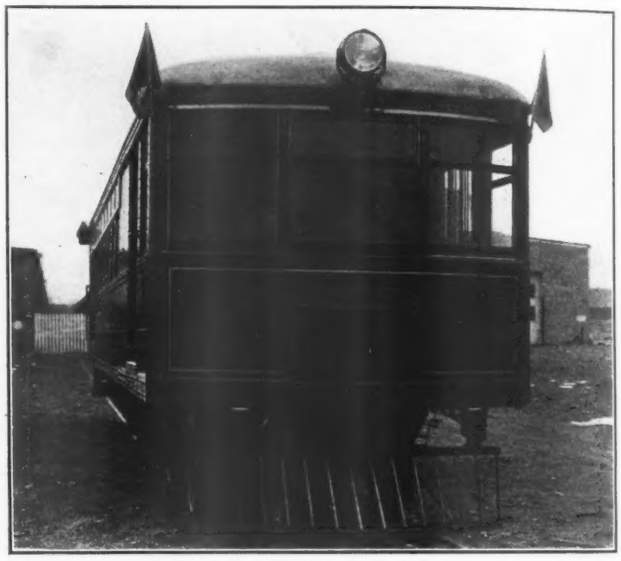
Interior of the Passenger Compartment

The ends are tapered to receive the wheels which are also secured by keys. The axle bearing housings carry the semi-elliptic springs the ends of which are shackled to and support the truck frames.

The wheels on both the driving and trailing truck are of unique construction. The centers are of cast steel with tires of rolled steel 30 in. in diameter over the treads. Between the center and the tire is placed a rubber cushioning element consisting of two rings of rectangular section one on either side of a metal web cast integral with and projecting outward from the middle of the wheel center face. The lateral thrust between the wheel center and the tire is taken by inwardly projecting flanges attached to both sides of the tire, which overlap the wheel center.

Each truck is provided with four brake shoes operated by a link arrangement similar in principle to that formerly employed on the driver brakes of American type locomotives. These brakes are operated by a hand wheel through an irreversible worm and gear, with a pawl for locking the wheel when the car is unoccupied. An independent emergency brake, operating on the propeller shaft drum is also provided. Although not included as regular equipment on the car, Westinghouse traction brake equipment can be installed if desired.

The motorman's seat is located at the left of the engine hood. The controls consist of a foot operated clutch, a hand operated gear shift, hand operated spark and throttle controls with a foot operated auxiliary throttle, and the hand brake wheel, or brake valve if the car is equipped with air brakes.



The Front End of the Service Coach

On a recent run from Wabash to Elkhart, Indiana, a distance of 68.6 miles the trip was made with an average speed of 28.6 miles an hour and a maximum speed of 45 miles an hour, the total time of the run being 2 hours and 24 minutes. The average fuel consumption was at the rate of 5.3 miles per gallon of gasoline, while the total oil consumption was less than one quart for the round trip of 137 miles. From a standing start the car accelerated to 25 miles an hour in 30 seconds, 29 miles an hour in 1 minute, 35 miles an hour in 2 minutes and 41 miles an hour in 2 minutes and 40 seconds.

The Economic Operation of Superheater Locomotives—Another matter affecting road performance that is too frequently overlooked or ignored is the absolute necessity for employing a pyrometer. In many instances the use of this instrument has been abandoned because of its alleged unreliability. But it is without question that a dependable temperature gage—and there is at least one such on the market—is indispensable to the economic operation of the superheater locomotive. Without it, neither the driver nor the fireman can tell what the degree of superheat is on the road, and consequently the engine cannot consciously be driven and fired in such a way as to produce the best results. It is possible, of course, that the engine may be working economically; but on the other hand, it is far more likely that the reverse will be the case and that no superheat of any value is being obtained. If a superheater is worth fitting at all it is worth being used in an effective manner, and it cannot knowingly be so used unless it is possible at all times to ascertain the steam temperature by means of a pyrometer. The pyrometer is just as essential as the pressure gage and no superheater locomotive can be said to be intelligently handled if it is absent.—F. W. Brewer in The Engineer.

Some Notes on Railway Refrigerator Cars*

Requirements for Efficient Refrigeration; Importance of Air Circulation and Insulation

By W. H. Winterrowd
Chief Mechanical Engineer, Canadian Pacific

THE subject of railway refrigerator cars has been, and is still one of growing importance, a growth that has been contemporaneous and proportional to the development of the United States and Canada and their communities, and to the resultant demand and necessity of transporting increasing quantities of perishable commodities greater and greater distances. When hauls were short and the variety of perishable commodities few, the problem of transporting and protecting the commodities from heat or cold was comparatively simple. Increasing distances and a greater variety of perishables not only made necessary greater numbers of, and more efficient cars, but involved the establishment of railway-divisional and terminal facilities, upon

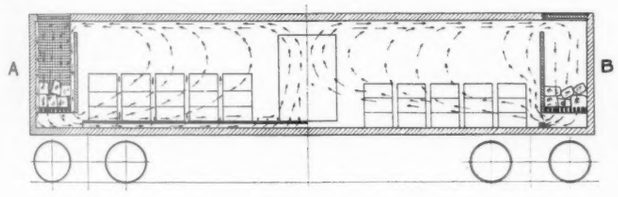


Fig. 1—Diagram of Air Circulation

which the successful operation of this type of equipment is contingent.

Comparatively speaking, literature upon the subject is not vast, although exceedingly valuable. Finding the sources of information to some extent scattered, the writer has attempted to include under one heading some of the most interesting and important facts regarding principles and methods involved, as well as to present some information regarding the type of cars and methods of construction used by various railways and private-car owners.

Refrigeration of Commodities in Transit Involves Many Factors

The prevailing method of obtaining refrigeration is by means of naturally-circulated air, cooled by contact with ice, or ice and salt, placed in suitable receptacles called bunkers located at each end of an insulated car. Some modifications of this system will be touched upon very briefly later.

Circulation is assisted and made most efficient by means of insulated partitions, called bulkheads, placed in front of the containers and so constructed that the relatively warm air must pass over the top of them to reach the ice, or ice containers. The air becoming chilled, and therefore heavier, sinks toward the floor and reaches the body of the car by passing through a space beneath the bulkheads.

These insulated partitions also assist in protecting the lading nearest the ice containers. Without bulkheads, and when salt is used with the ice to hasten and increase refrigeration, that part of the lading nearest the ice frequently freezes, an undesirable and disastrous occurrence with some commodities. At the same time, that portion of the load near the center and top of the car may remain at too high a temperature, an equally undesirable condition.

As a further aid to circulation, particularly in cars where the lading is piled or stacked, a slatted wooden structure known as a floor rack is of very great value. These racks, on the top of which the lading may be placed, consist of longitudinal runners 3 or 4 in. high, with cross slats fastened to the top of them. They are hinged to the side walls of the car and are divided in the middle so that they can be turned up to make the floor accessible. These racks permit the cold air which flows beneath the bulkhead to circulate freely toward the center of the car and up through the lading.

Illustrations of Effect of Design

The *A* end of the car, Fig. 1, shows the relative arrangement of bunkers, bulkheads and floor racks, and the resultant trend of air circulation.

It is highly desirable that there be no obstruction to the flow of cold air where it passes beneath the bulkheads. The *B* end of the car, Fig. 1, shows how an obstruction at that point can act as a dam or deflector of the air currents, and partially or entirely defeat the object of the floor racks, and

Fig. 2—Car With Fixed Bulkhead and Basket Bunker, Floor Racks Raised

even cause frosting of the lading against the insulated bulkhead. If floor, bunker or splash-board construction necessitates a ledge beneath the bulkhead, it should be kept as low as possible and the floor rack and bulkhead so designed to provide sufficient area for a free flow of air.

At the *B* end the lading is shown piled directly on the floor and the air currents indirectly indicate the advantage of floor racks. Fig. 2 illustrates these racks, showing their appearance when turned up against the side walls.

The method of loading various commodities is an important factor in their proper refrigeration in transit. To obtain the greatest advantage from circulation, the contents of the car should be loaded so that the air can come in contact with a maximum surface with a minimum of restricted circulation. It is easy to understand that boxes or containers, placed

*From a paper presented before the American Society of Mechanical Engineers at New York, May 16, 1922.

closely against each other and against the walls of the car cannot be cooled quickly or properly preserved at as uniform a temperature as when placed so that air can flow between them, or generally speaking, throughout the entire load.

The temperature of the circulating air is affected by the type and size of ice containers or bunkers. The chief considerations in the construction and capacity of the bunkers are the refrigeration required to replace the loss due to transmission and the refrigeration required to cool the car quickly and maintain its contents at the required temperature. The loss in transmission in turn depends upon insulation, car construction and maintenance; factors which will be more fully discussed later.

A basket bunker is shown in the *A* end of the car in Fig. 1, and a box bunker in the *B* end. Brine tanks are shown in Fig. 3.

The sides of the basket bunker are constructed of wire mesh. The bottom consists of a slatted wooden structure. The bunker is placed in position so that air space exists around the outer surfaces, this construction permitting the air behind the bulkhead to come in contact with a maximum ice area, while the open spaces around the bunkers facilitate circulation.

The bottom of the box bunker shown at the *B* end of the car in Fig. 1 is also slatted. The walls are formed by the bulkhead and by the sides and end of the car. In an endeavor to make the refrigerator car more productive and useful for general purposes, some builders have applied collapsible box bunkers. In this design, the bulkhead is swung up, or to one side, and fastened. The slatted rack is swung or folded back against the end of the car. In this

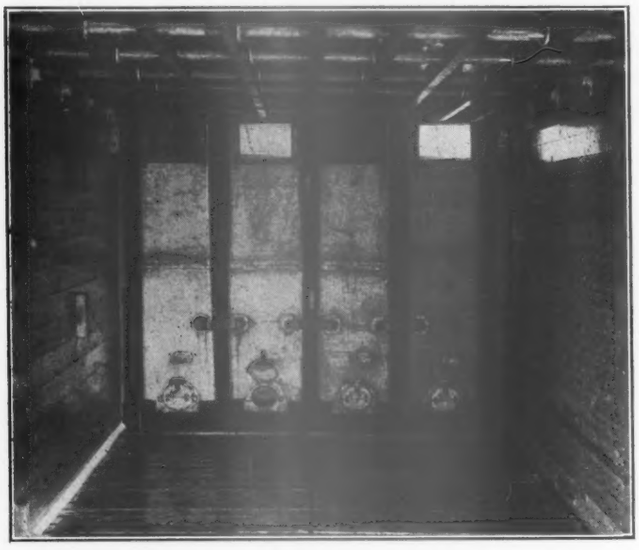


Fig. 3—Brine Tanks in Refrigerator Car, Bulkhead Swung to Side

way the space occupied by the bunker is made available for general lading.

Another very important factor is the size of the car and its proportions, particularly with reference to the distance between the bulkheads. The cold air passing out beneath these insulated partitions flows toward the center of the car. In doing its work it gathers heat and grows warmer. If the distance between bulkheads is too great, the air may not be at a low enough temperature when it reaches the center of the car to properly refrigerate the load at that point, particularly near the top of the car. Under such conditions a portion of the load near the bulkheads may be sufficiently chilled while the upper and center part of the load may be too warm. The chief factors generally considered in this connection are type and capacity of car, type of bunkers, amount of commodities and size of containers, and temperature required for efficient refrigeration.

Importance of Temperature of Entering Load

The temperature of the entering load is a very important factor. If heat is not removed from certain commodities prior to loading it is highly desirable to remove it as quickly as possible after loading. Tests and general experience show that if the heat is not promptly reduced, the commodities either spoil en route or reach their destination in such condition that their market value is greatly reduced. Quick cooling after loading is generally attempted by pre-cooling

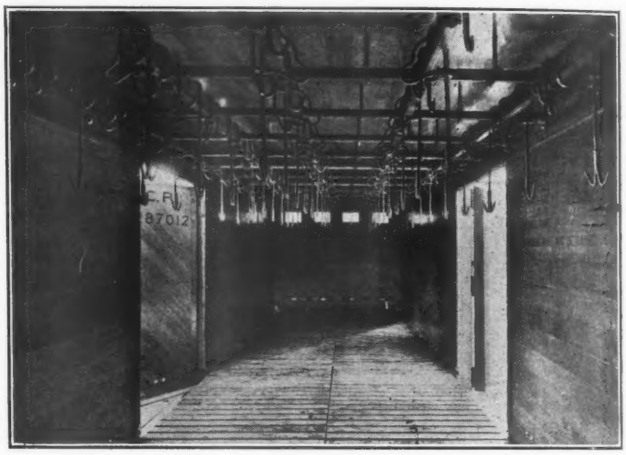


Fig. 4—Meat Rack and Hook Installation

the car, by the use of cars in which maximum and most efficient air circulation can be obtained and by mixing a proper amount of salt with the ice or by placing coarse rock salt on top of the ice.

When salt is mixed with the ice, the greatest amount is used at the first icing, the time when the greatest quantity of heat is in the lading. At the second icing the amount is generally reduced, while at the third and successive icings a stipulated minimum amount is used.

Pre-cooling the car may be accomplished by the use of ice and salt, but at many points where a large tonnage of fruit or meat originate, the cars as well as the lading are often pre-cooled by mechanical means.

Pre-cooling means less ice in transit, a matter of economy to shippers and railways alike. Some commodities can be frozen hard and therefore require little or no icing en route, the lading itself supplying the necessary refrigeration. This not only insures better condition in transit but is an added economy.

Humidity or moisture content of the air in the car is almost as important as temperature. Generally speaking, if refrigeration is effective and a high initial rate of cooling obtained, the air is kept sufficiently dry due to condensation taking place on the surface of the ice, or ice containers. In this way the moisture given off by some classes of lading is also deposited. Excess of humidity, if not fatal, is highly injurious to many commodities.

Insulation Is the Most Important Consideration

Finally we come to the matter of insulation, the most important factor in connection with efficient and economical refrigeration. The function of the insulation is to afford protection to the lading by minimizing heat transmission through the walls, roof, and floor of the car. To do its work properly it must be by nature a poor conductor of heat. Other desirable qualifications are reasonable cost, strength, adaptability, durability, light weight, and imperviousness to moisture.

This subject might well be divided into two parts, insul-

ating materials and insulation, because the general subject involves methods of car construction and maintenance in addition to the consideration of materials and principles of heat transmission.

The whole subject is capable of analysis but that the principles involved are not broadly known is indicated by the fact that in very recent years cars have been built without proper or sufficient insulation. These cars which do not properly protect their lading are huge consumers of ice and, moreover, are expensive to operate and require a great deal of maintenance in order to keep them in service.

Summation of Requirements for Efficient Refrigeration

It is evident that an efficient and economical railway refrigerator car is one which provides adequate air circulation, adequate protection to the lading, adequate quantity and degree of refrigeration, quick initial cooling, uniform temperatures, dry air, space to permit proper methods of loading, and good car construction to minimize maintenance and increase time in service.

(An abstract of the remainder of Mr. Winterrowd's paper will be published in the next issue.—EDITOR.)

Important Factors in Freight Car Design*

Capacity of Truck Springs and Draft Gear; Size of Center Sills and Location of Center Line of Draft

By Louis E. Endsley

Consulting Engineer and Professor of Railway Mechanical Engineering, University of Pittsburgh

IN the design of a freight car, there are two distinct problems to be taken into consideration. One is the direct vertical load and the other is the shock or pressure produced between the cars when they come together at varying speeds. Let us consider first the direct vertical load.

There are some parts that need to be heavy to absorb the shocks of the direct vertical load, but none of the parts above the springs should receive shocks therefrom. What I mean by shock is that force which is produced after the part which is designed to give under varying movements of the car, has gone solid. These parts in the direct vertical design are the springs. I am confident that the springs should be designed with a greater capacity than some designers are now using. Some cars are now designed and put in service with the capacity of the spring only 160 per cent of the normal weight of the car and lading, normal weight being considered as the load on the springs when the car is standing still. In my opinion, this capacity of spring should not be less than 200 per cent and 250 per cent would probably be better. That is, only 40 per cent of the total movement of the spring should be taken out of the spring when the car is loaded and standing still.

Tests of Truck Spring Action

In some tests that I made on the Pennsylvania Railroad in 1914, I used a recording arrangement to determine the movement of the bolster up and down upon the springs, with respect to the side frame. By the use of calibrated springs I was able to determine whether the springs went solid and if they did not go solid, the maximum force upon the side frame. I used for this series of tests two different capacity springs; one set had a capacity of a little more than 200 per cent of the normal load and the other had a little more than 300 per cent of the normal load. In the 200 per cent capacity springs, in trips of the car between Pittsburgh and Alliance, many solid impact blows were delivered between the bolster and side frame, that is, the springs went solid many times.

This solid impact never occurred from one low spot in the rail or crossover, but was an accumulation of vibration up and down on the springs, usually from synchronizing of low spots in the rails or from vibration, up and down, of the car synchronizing with one revolution of the wheel. It usually took 30 up and down vibrations as shown on the recording apparatus, to cause the springs to go solid. The other set of springs, which were 300 per cent of the normal load, never went solid. In fact, there was only one impact recorded that was over 225 per cent of the normal load. This car was run both in local and fast freight. The total movement of the springs, free to solid, was 1¾ in. on the 200 per cent capacity springs and 1⅛ in. for the 300 per cent capacity springs.

This is a point which I wish to emphasize. I am of the opinion that some designers allow too much movement in the car, up and down; that is, allow too much spring travel. I am of the opinion that an inch travel or thereabouts of the spring will give less chance for excessive impact blows than if we used two inches or thereabouts.

The two sets of springs which I referred to before were of the same total height, but the free movement was reduced on the heavy capacity springs due to the increase in capacity. If, as I said before, a designer uses a capacity of 160 per cent of the normal load and the springs are designed for a maximum stress of 80,000 lb. per sq. in., he will have ⅝ of that stress upon the spring when the car is standing still, or 50,000 lb.; while if he uses a 250 per cent capacity spring, he will only have a stress of 32,000 lb. per sq. in. when the car is standing still. This last spring will not be under nearly as heavy strain; the breakage of springs will, in my opinion, be materially reduced, and we will get very few impact blows upon the bolster and side frame of the freight car.

Effect of Shocks on Side Frames

Of course, those parts of the car which are below the springs, namely the side frame, need some extra weight in them, due to those parts coming into contact with any abrupt irregularity of the track and producing an impact blow, due to the side frame's own weight; but on those parts above the springs, if they do not go solid, the design is easy from a direct vertical standpoint. In some tests that I ran some years ago to determine the effect of the impact blow upon the side frame, after the springs went solid, I mounted in the standard M. C. B. drop testing machine a cast steel side frame. This side frame was supported upon blocks of wood to represent in a way the give of the track and was mounted also upon the 17,000 lb. anvil of the standard M. C. B. machine, which in turn is mounted on springs. A 9,000 lb. weight was allowed to drop and strike upon two ends of a short improvised bolster which rested upon the standard set

*Abstract of an address delivered before the Virginia section of the American Society of Mechanical Engineers, at Newport News, Va., April 7, 1922.

of springs that were supported by the side frame. I found that a drop of this 9,000 lb. weight of 12 in. would just put the springs solid. If I raised the hammer another inch, or 13 in., and then dropped it, the side frame, which had an elastic limit of double the spring capacity, would take set. In other words, it only takes a little more energy than that necessary to close the springs to cause some very excessive forces. This is what is occurring in some cars when the bolster springs go solid, so that if you design a car with springs that go solid, you are somewhat in the dark as to the stress being produced in the car. It is perfectly safe to use a stress of 16,000 to 18,000 lb. per sq. in. in the underframe of the car from a direct vertical load standpoint, if you know with certainty the force coming upon the springs, but if the springs are going solid, it may be necessary to use a stress of only 10,000 lb., or in other words, a factor of safety of considerably more than that which would be necessary, if the springs were not going solid.

Design of Underframes

In the detail of the design of the underframe, I am of the opinion that rolled members will give more satisfactory and more uniform results than will pressed sections. This is due to the fact that the corners of the rolled section materially add to the strength of the member, and also pressed sections are not as a rule as straight and uniform as the rolled sections.

With regard to the forces which come upon the car due to their being switched or allowed to run into another car, there are some other problems which have not as yet been solved, but we are here confronted with the same problem that we are confronted with in the bolster springs. If we had a draft gear in each car that would never go solid without a pressure above the coupler and sill strength, when it came into contact with another car, we would have the problem practically solved, but as we have never yet been able to keep our switching speeds below the impact point, we are confronted with the same problem, by reason of the impact, which is indeterminate after the draft gear goes solid. Some years ago we used a wooden underframe for our freight cars, and the line of draft was considerably below the center line of sills due to the fact that the sills were upon the body bolster and raised the center line of sills. Now, when we have steel construction and the sills of the car and the body bolster can be on the same horizontal plane, we are able to get the line of impact almost in the center line of sills in car. We have, though, taken away some of the relieving qualities which allowed the old wooden frame to bend and give, for wood, having a much lower modulus than steel, gives approximately 15 times as much under the same stress as steel, and this mere fact made the underframe of the old wooden car quite a giving medium. Today, the underframe of the car, if strained from end to end, above its elastic limit, will give less than one inch, while the old wooden car would give more than two inches and not overstrain it, and the old wooden car and its lading was much better protected than the new cars with the steel underframe.

Today we are attempting to put in a draft gear that has a travel of two or more inches, most of the draft gears having something like 2¾ in., some draft gears have been constructed with 3½ in., and a few have been built with 4¾ in. In my opinion, we are now ready for an increase in the travel of the draft gear itself, because if we attempt to absorb in the average travel of say 2¾ in. we are expecting entirely too much of the draft gear. In other words, to get the capacity that is necessary out of the 2¾ in. travel draft gear will require, if the line is a straight line relation, between movement and pressure, a very excessive final pressure, or above that which any designer has yet obtained, while if we should go to 4½ in. or 5 in. travel, we could design a draft gear of almost four times the capacity of the 2¾ in. travel and still have no greater increase in the relation between pressure and travel.

Relative Strength of Center Sill Channels

The weight of the underframe today has been increased for the protection mainly of the impacts between cars. In some tests which I made a few years ago, it was found that two 30-lb. 12-in. channels with a cover plate of 5/16 in. will stand an impact force of over 1,200,000 lb.; while if these channels were of the same weight and 15 in., the web and flanges were thinner and did not give as high an impact force as the 12-in. channel. Some designers have gone to the high channels for the mere purpose of protecting the car from the vertical oscillation, while if they would go to a heavier capacity spring in the truck they could still retain the 12 in. channel of less weight and have as good impact and absorbing medium as if they had the 15 in. channel.

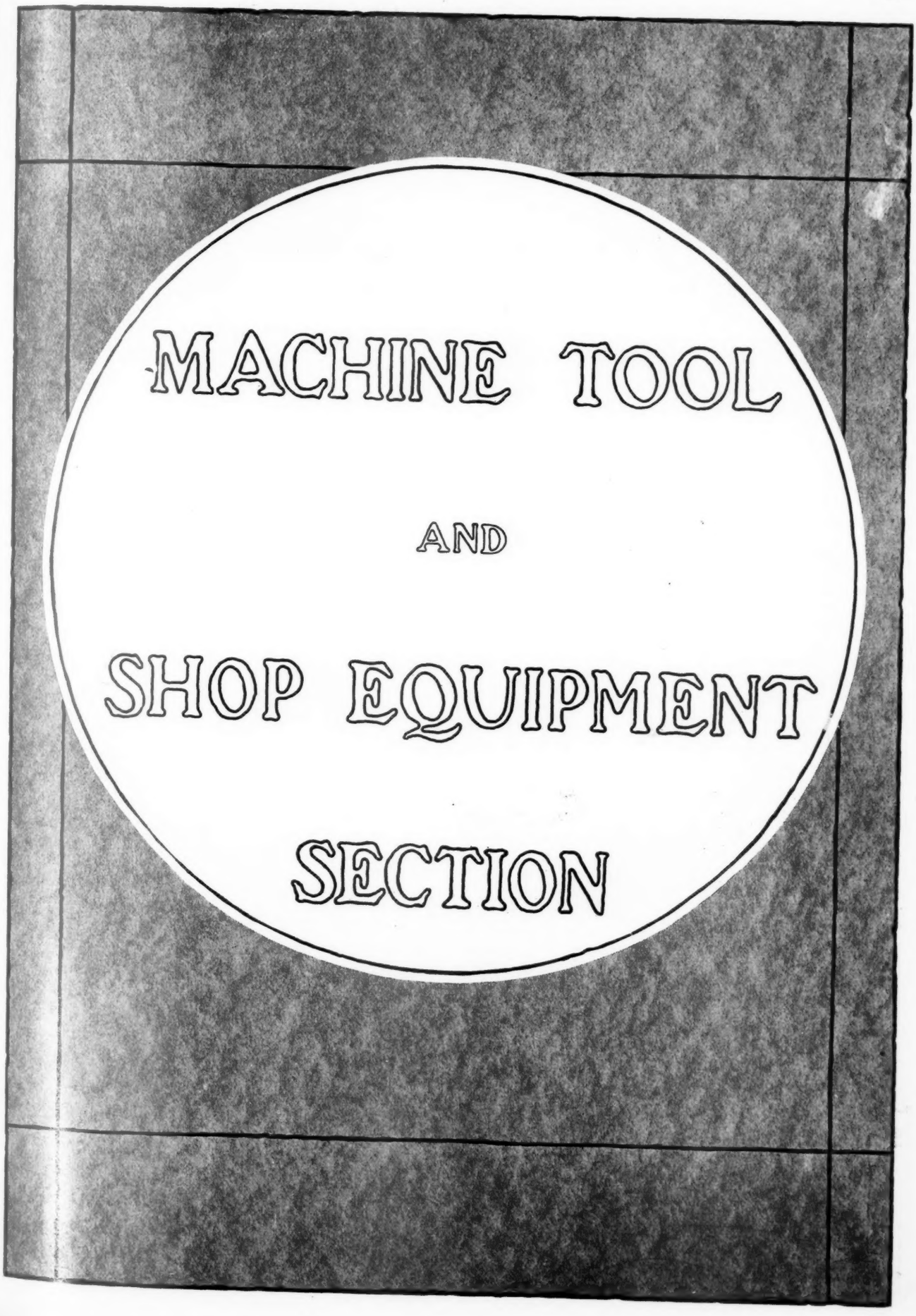
We now have a standard coupler which is a very good coupler. This coupler is of such strength that we will have to design the underframe of the car a little stronger than we have been designing it in order that the underframe will be of greater strength than the coupler, because the underframe should be stronger than the coupler, as it is much cheaper to replace a coupler than to repair the underframe.

Importance of Draft Gear Capacity

I am of the opinion that we should take steps to keep our draft gear capacity up so that we can keep in the service longer the old and medium weight cars. If our old cars have an impact capacity of only 600,000 or 700,000 lb., and we design cars with a new underframe that has a capacity of over 1,000,000 lb. and these cars come in contact, without an adequate draft gear in each of them, there is not much doubt which one of the cars is going out of commission. As long as we keep together two cars of equal strength, they will stand a great many impact blows in the switching, after the draft gear goes solid, but when they come into contact with cars of greater capacity, the old cars will go out of commission very fast; while if we should design the new cars with draft gear and arrangements that would take care of a reasonable switching speed, we would keep in service many cars which are now going out of service. Today we have draft gears which will take care of switching speeds between 3½ and 5 miles an hour when new, but unless they are kept under repairs, this speed at which they will protect the car will be reduced considerably. After the draft gear goes solid, as with the springs, it does not make any difference how strong you make all the parts of the car, you will still be overstraining them if the switching speed is sufficient to close the draft gear.

An important thing to be kept in mind in the design of a car is to get the line of draft as near the center of the channel that makes up the underframe as possible. Some designers have felt that it should be slightly below the center of the channel, but I believe that an inspection of bent underframes will show the weakest point of the car is just behind the bolster on the bottom of the sills. This is due to this point being under compression, due to the direct vertical load, also due to the impact on the end of the car. If the center line of draft cannot be put upon the center line of sills, it would be better to put it a little above than below.

Some designers are attempting to design the draft gear and attachments so that they can be easily taken down and inspected and repaired, but some roads do not seem to appreciate the benefit of keeping the draft gears in repairs. I believe that taking out the slack, which is bound to be produced by bending of parts after the draft gear goes solid, should be practically carried out; in this way we would be able to materially reduce the uncontrolled slack in operation of cars as, in my opinion, there is a marked difference in uncontrolled slack of a long train and draft gear travel.


MACHINE TOOL
AND
SHOP EQUIPMENT
SECTION

Heavy Duty Boring and Turning Mill

MANY improved features have been incorporated in the new line of boring mills, manufactured by the Colburn Machine Tool Company, Cleveland, Ohio, making these machines powerful yet easy to control and therefore well adapted for use in railroad shops. The machines are made in sizes from 36-in. to 84-in. swing inclusive, the following description pertaining to the 42-in. mill which is representative.

The actual swing of the 42-in. mill is 44 in., 36 in. under the cross rail and 41 in. maximum distance between the table and lower face of the turret. The table is 40 in. in diameter cast solid (not cored underneath) and provided with both parallel and radial T-slots. The table spindle has a chilled cast-iron angular bearing of large diameter at the top which makes it self-centering. This, in combination with the large vertical bearings, effectively resists all tool thrusts and strains. Two swivel heads can be provided as shown in Fig. 1, or one swivel and one turret head as shown in Fig. 4.

The drive consists of a primary and secondary speed unit, the secondary unit being located within the bed or base, where three changes are obtained. The primary unit constitutes the feed change gear box and provides four additional changes, thus giving a total of 12 speeds. These speeds range from 2¼ to 70 r.p.m. in geometrical progression, being easily available by means of levers within easy reach of the operator when standing at the right-hand side of the machine.

The cross rail is of the narrow guide bearing type being raised and lowered by power independently of the table drive. The heads are entirely independent in their movements both as to direction and amount of feed and each is operated by a Colburn Swastica control through separate feed boxes. Either head can be brought to the center of the table for boring, the exact central position being determined by a positive, hardened center stop.

The turret head is moved horizontally and vertically in the same manner as the swivel head, the turret slide having a vertical travel of 26 in. The five-sided turret is 13 in. in diameter with holes to fit tool holder shanks 2½ in. in diameter. The turret is tilted to an angle of eight degrees

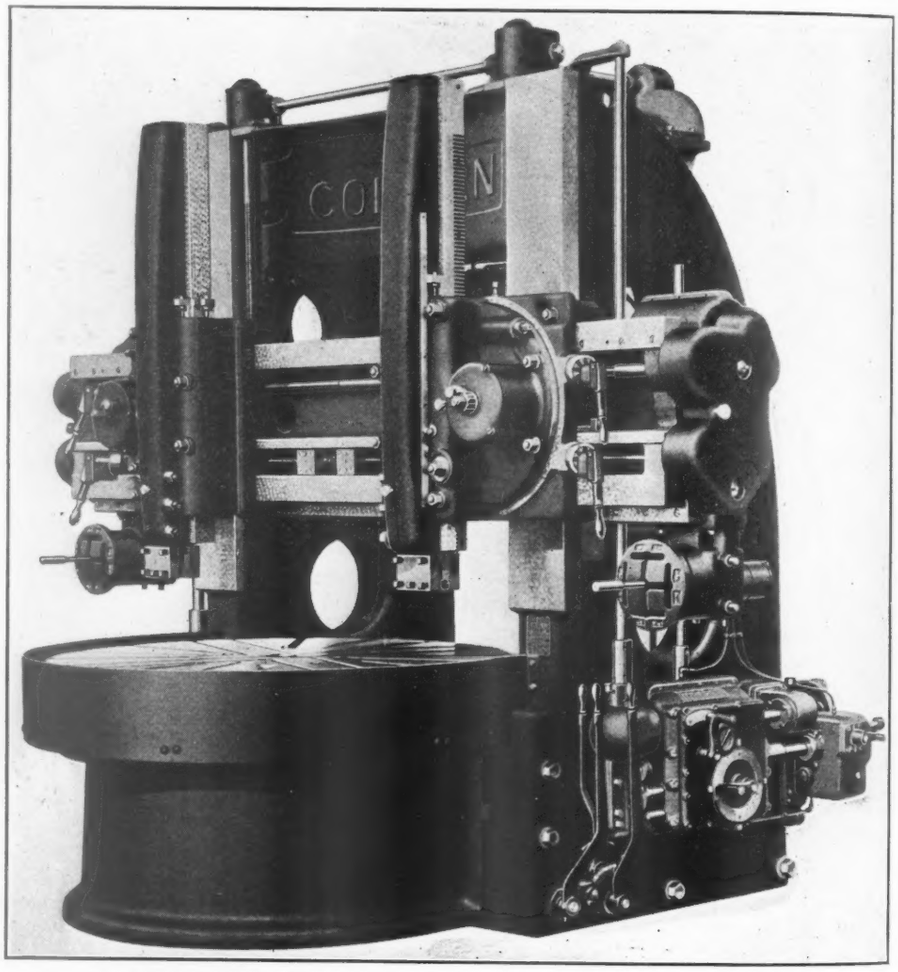


Fig. 1—Colburn Vertical Boring and Turning Mill with Two Swivel Heads

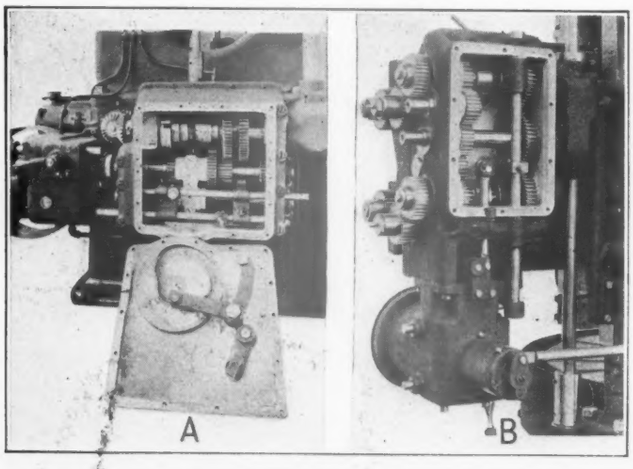


Fig. 2—Feed Change Gear Box and Feed Clutch Gear Box

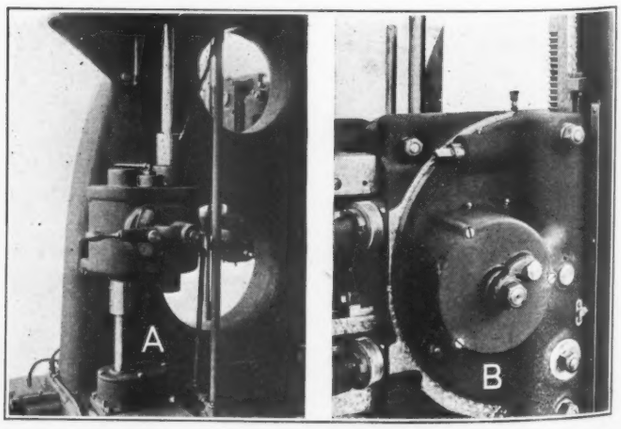


Fig. 3—Rail Elevating Device and Spring Counterweight for Ram

which gives ample clearance for large tools when swung over the slide. Rams on the plain head swivel 45 deg. either side of the vertical position, graduations on the swivel, indicating the angle. The rams have a vertical and angular travel of 30 in. Angular adjustment of the ram is accomplished by means of a worm and segment both wholly enclosed in the head. A rapid and convenient means for

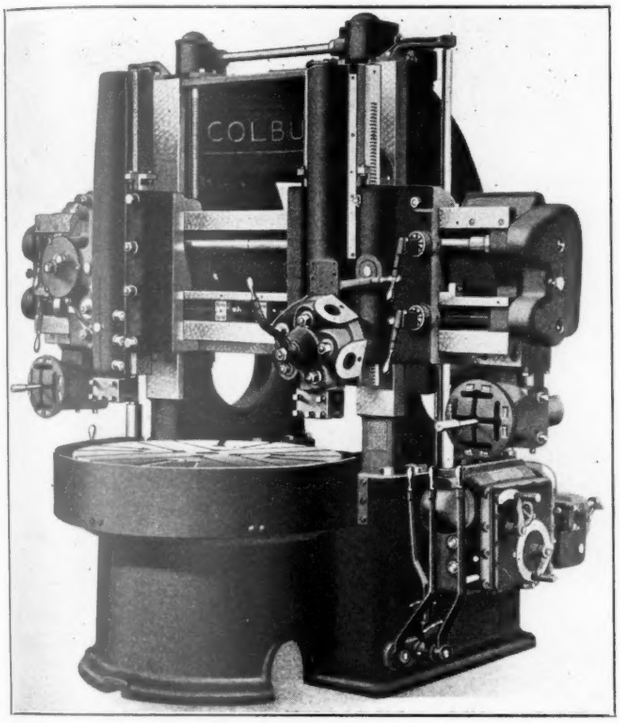


Fig. 4—Colburn Mill with One Turret and One Swivel Head

setting the ram at any desired angle is thus afforded, also acting as a safety lock to prevent tipping when the swivel clamping bolts are loosened.

The complete control for each head and ram for both feed and rapid traverse is obtained by a single lever. The lever is always thrown in the direction of the movement desired, whether it be feed or traverse. This control is so designed that when the rapid traverse is engaged the feed is disengaged and vice versa. Furthermore, the rapid traverse always operates in the opposite direction from the feed in each slot shown on the control plate. Sixteen changes of feed in horizontal, vertical or angular direction are obtained ranging in geometrical progression from .006 to 1 in. per revolution of the table.

The feed change gear box, illustrated at *A* Fig. 2, shows the cam arrangement for shifting the gears. Immediately to the left of the open gear box is the feed multiplying gear which works in conjunction with the first mentioned gear box, the gears of which are controlled by the lever *Z*. The feed clutch gear box is illustrated at *B* Fig. 2 which shows the connection to the single lever control; also the method of engaging clutches through this control.

The rail elevating device is shown in a close-up view at *A* Fig. 3. This device consists of friction clutches and gears contained in one compact unit and controlled by the single lever shown. The spring counter-weight for the ram, illustrated at *B* Fig. 3, is a patented device eliminating the use of weight, cables, sheaves, wheels, etc. The spring is heavy and has been given a thorough try out. The ratchet adjustment is simple, providing a ready means for proper counter-balancing the ram when heavy tools are used.

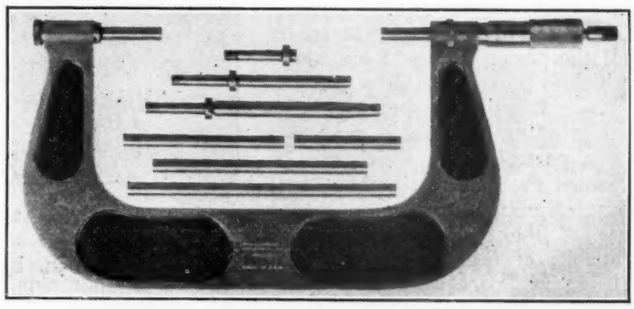
Power rapid traverse permits the heads and rams to be moved horizontally, vertically and in angular directions by power at the rate of approximately 12 ft. per min. The rapid traverse may be operated with the table in motion or at rest. Final adjusting ratchets for vertical and horizontal movements are mounted on the heads and carry adjustable micrometer dials, reading in thousandths of an inch.

Great attention has been given to the proper lubrication of this machine and a large amount of space would be necessary to describe in detail its automatic gravity flow lubricating system. All units not automatically lubricated run in oil baths and require only periodic attention. Single pulley or motor drive by means of a 10-hp. constant speed electric motor running at 1,200 r.p.m. can be provided. The brake is operated by a starting and stopping lever permitting the operator to stop the table instantly at any predetermined point. The brake is on the prime mover, strains resulting from stopping quickly not being transmitted through the gearing. The safety of both operator and mechanism have received careful attention and the table is guarded and gearing enclosed as illustrated. All speed changes are readily made from the regular working position. A starting and stopping lever is located at the front on both sides of the bell and the brake is operated simultaneously with the disengagement of the driving clutch.

Micrometer Calipers With Increased Range

TO provide an accurate micrometer caliper for measurements from 2 in. to 6 in., the Brown & Sharpe Manufacturing Company, Providence, R. I., has changed the range of its micrometer caliper No. 55. The increased range of measurement is obtained by four anvils furnished with the micrometer. These anvils are easily and quickly changed, being held positively in place by a knurled nut. One anvil is for measurements from 2 in. to 3 in., another from 3 in. to 4 in., and so on.

The need for a tool of this range has been brought about by the introduction of small pistons in the automobile motor but the tool is by no means limited to that field of usefulness, there being many occasions when micrometer calipers of this range are needed in railway toolrooms. The new tool measures the same range of work as a more expensive set of three or four micrometers. In general construction it is similar to other Brown & Sharpe micrometer calipers, the readings being easily and quickly taken. The shape of the frame is especially well adapted for all around use, enabling it to be conveniently handled.



Brown & Sharpe No. 55 Micrometer with Increased Range

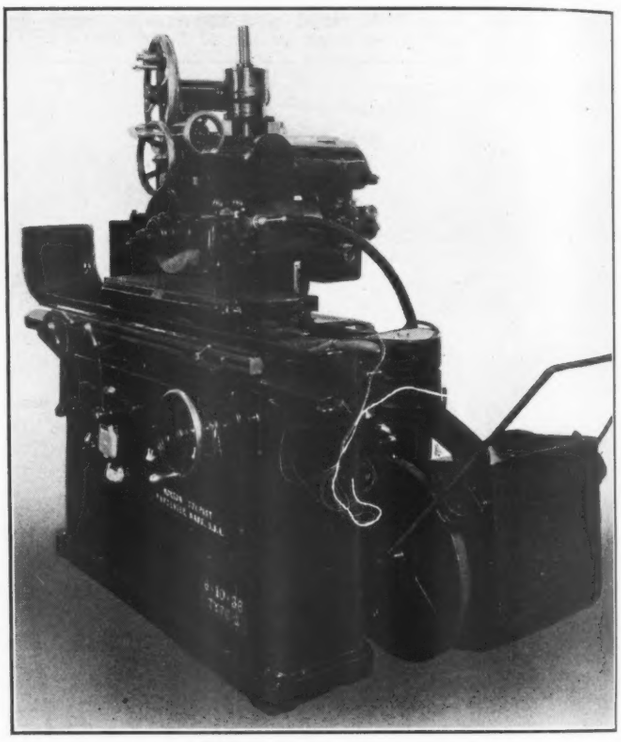
Universal and Openside Surface Grinders

TWO new grinding machines, including a 12-in. by 36-in., type *L* universal multi-purpose grinder and a 6-in. by 10-in. by 36-in., type *G* openside surface grinder have been brought out recently by the Norton Company, Worcester, Mass. These machines embody the latest features of Norton design and are both self-contained. The universal machine is arranged for single pulley drive either from a line or countershaft, or direct from a motor, while the surface grinder is driven by a motor bolted to its base. The simplicity of the set-ups for various grinding operations on the universal machine such as for internal grinding, taper grinding, grinding a bevel collar and face grinding makes this machine desirable for railway toolroom work where many jobs other than straight tool work are sometimes handled.

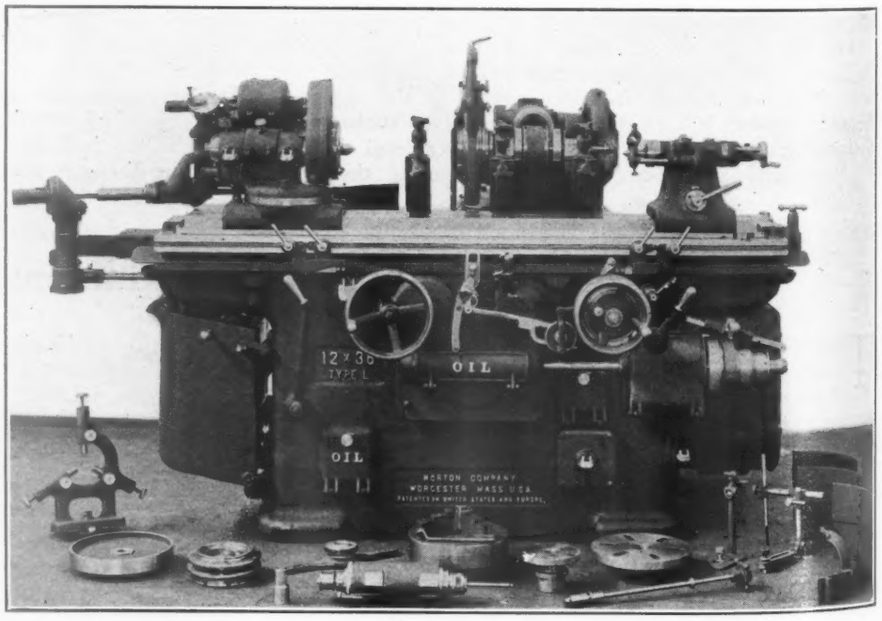
An important feature embodying new ideas of design is the method of transmitting power from the countershaft in the base of the machine to the wheel spindle. This is done in such a manner that the belt passing up over idler pulleys can be twisted to any of the positions to which the wheel head may be set either for regular or internal grinding. This arrangement of the driving belt to the wheel spindle has made it possible to make the wheel head double-ended, carrying the regular wheel spindle at one end and an internal grinding spindle at the other. As will be seen from the illustration the drive to the headstock is through a blind shaft. Six work speeds ranging from 53 to 320 r.p.m. are obtained by a bank of gears and a sliding key contained in the headstock, all work speeds being entirely independent of the table speeds or wheel speeds. The headstock spindle is hollow so that rods up to 3/4 in. in diameter may be passed through. Provision is also made so that the center may be rotated or stopped as required.

The type *G* openside surface grinding machine has been designed for the rapid production of precision work. This is a powerful machine for its size and is adapted to the grinding of many flat faces on motion work and the machine parts of locomotives. Particular attention is called to the improved spindle bearing construction with flood lubrication and thumb screw adjustments. The wheel spindle is designed to eliminate sticking and requires no attention once the thumb screws are adjusted while the wheel is rotating at its normal speed.

Other features which merit special attention are the compactness of design, convenience of operation and high table traverse speeds which assure high production. The latter point is emphasized by the size of the wheel and the diameter and width of the spindle pulleys. These are of ample size to utilize all the power of the 15-hp. motor which is provided to drive the machine. It will also be noted that the grinding lubricant is contained in a portable tank which can be cleaned in a moment without serious interruption of the productive use of the machine. While the capacity of this grinder is to grind flat surfaces 6-in. by 10-in. by 36-in. work 8½-in. wide may be ground. The speed of the table is 80½ ft. per min. The hand table traverse engages automatically when the power traverse is thrown off. The wheel spindle makes 1,342 r. p. m., providing a surface speed on a 10-in. wheel of 3,515 ft. per min. The wheel is 3 in. thick. The spindle end thrust is taken up by a hardened steel flange between bronze washers, thumb screw adjustment being provided. The recommended speed of the main driving shaft is 815 r. p. m., the diameter of the driving pulley being about 14 in.



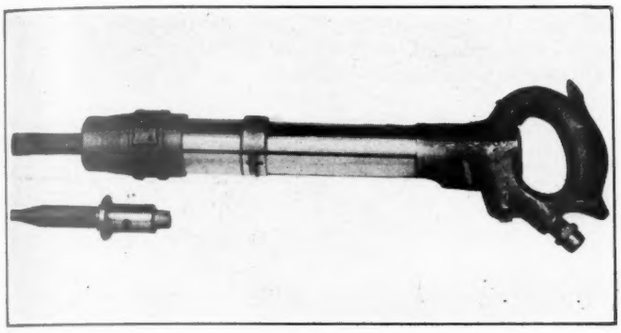
Six-In. by 10-In. by 36-In. Type G Openside Surface Grinder



Norton 12-In. by 36-In. Type L Universal Multi-Purpose Grinder

Pneumatic Tool for Removing Rivets

A PNEUMATIC tool for removing rivets, known as the Thor No. 90-S rivet buster, has just been placed on the market by the Independent Pneumatic Tool Company, Chicago. This is a substantial tool, as shown in the illustration, being similar in design to the Thor riveting hammer. It can be operated by one man instead of three and used in close quarters. The tool is well adapted for cutting off and backing out rivets of all sizes, its greatest value to railroad men being in the dismantling of steel cars.



Easily-Operated Thor Pneumatic Rivet Buster

The operation of this tool by one man instead of three results in a considerable labor saving. Rivets can also be cut in more difficult corners and there is less possibility of damaging the steel plates.

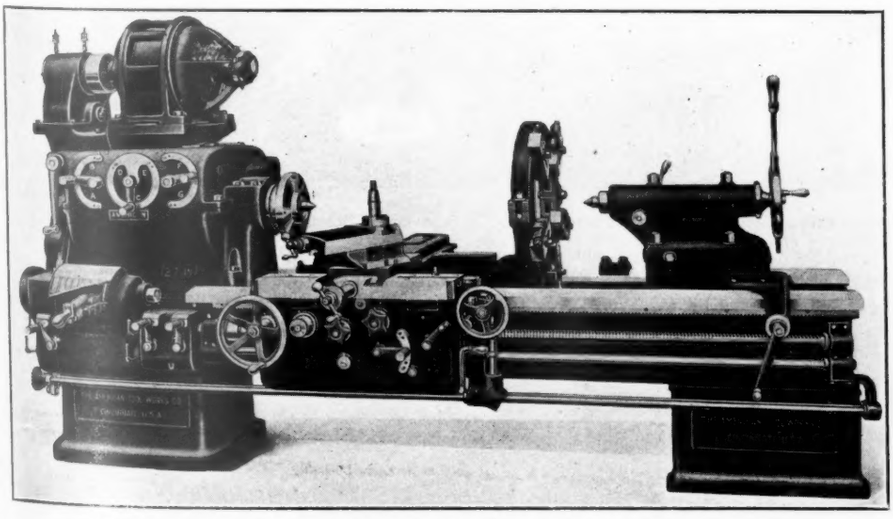
On account of the blows being rapid but not so severe the plates do not buckle at rivet holes, thus wasting expensive material as is often the case with the old style heavy three man buster. The Thor machine is designed to cut the rivet off smoothly at the surface of the sheet without disfiguring or spoiling the material.

The chisels and backing out punches are provided with individual safety retainers and can be quickly changed in the hammer from cutting off to backing out without disassembling the small retainer from the shank.

Engine Lathe with New Head and Motor Drive

A 24-IN. heavy pattern lathe with patented 12-speed gear head arranged for motor drive has been placed on the market by the American Tool Works Company, Cincinnati, Ohio. The interesting feature about this new lathe is the new design of head which now provides 12 speeds instead of 8 speeds, as formerly.

The automatic oiling system employed is also a new development, said to be a decided improvement in the lubrication of geared heads. By means of a geared pump, accessibly located inside the head, the oil is pumped from a reservoir in the bottom of the head to a filtering and distributing tank in the head cover. After the filtration takes place the oil gravitates to the various head bearings through oil pipes leading from the filter reservoir. Since the oil pump supplies considerably more oil to the reservoir than the bearings will consume, the surplus overflows and cascades over the gear teeth, thus keeping them constantly lubricated with clean oil. In order that any impairment of this circulating system may be immediately detected, gage glasses are supplied which indicate the oil levels and show the circulation of the lubricant. This new head is under instant control through either of two levers, one located at the right side of the apron, the other at the left side of the head. These levers operate the powerful friction clutch incorporated in the driving pulley or the driven gear of the motor train if motor driven. A powerful external band brake operates in unison with the friction clutch and is engaged when the friction is released, and vice-versa, consequently the spindle may be instantly stopped or allowed to drift when the driving friction is released, and in addition may be securely locked in its stationary position by means of the brake, thus guarding against the accidental starting of the spindle through possible drag of the friction.



American 24-In. Engine Lathe with New Geared Head and Motor Drive

Another valuable feature of this new head is that by the removal of one gear unit and its operating lever, it can be simplified so as to produce 4 speeds instead of 12, for the satisfactory use of a variable speed 2 to 1 or 3 to 1 motor instead of a constant speed motor.

The new motor drive connection adopted is also of interest, consisting of three steel herringbone gears with a patented flexible coupling between the motor shaft and the pinion which permits the motor armature to float without crowding the gear. This construction tends to provide a smooth-running, long-lived mechanism, and inasmuch as the entire unit is completely housed in and operates in an oil bath, it is practically free from noise.

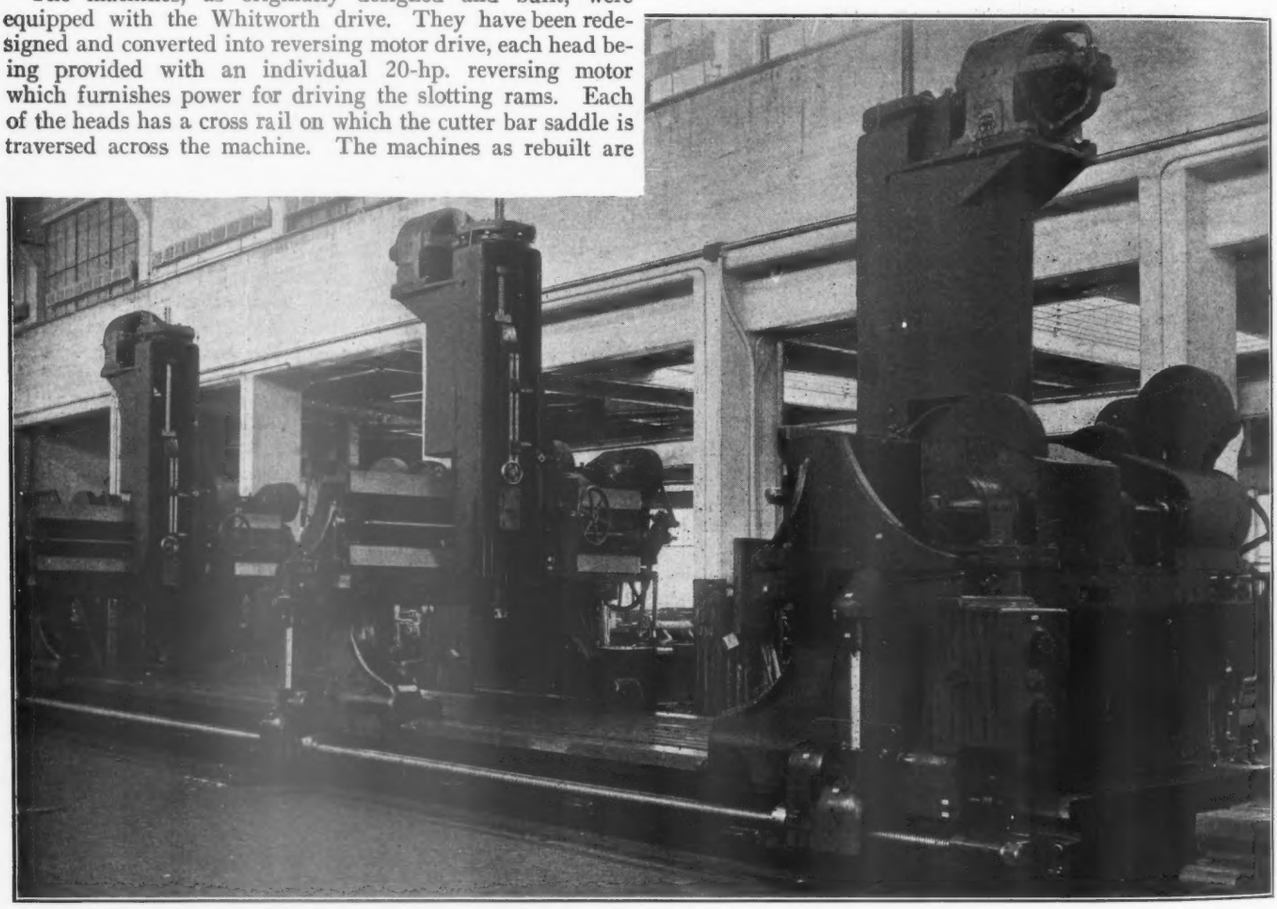
The modern engine lathe, of which this machine is a good example, is used so commonly in railroad shops that there is a tendency to underestimate its importance. Manufacturers are to be commended for developing those refinements in engine lathe design which increase production, thereby decreasing the cost of railway machine shop work.

Heavy Locomotive Frame Slotting Machine

THE illustration shows one of two locomotive frame slotting machines which were recently redesigned and rebuilt for the Dunkirk plant of the American Locomo- Company by the Betts Machine Company, Rochester, N. Y. These machines are used primarily for slotting out frames for new locomotives, and are also used quite extensively in repair shops for various kinds of work in connection with the rebuilding and repair of locomotives.

The machines, as originally designed and built, were equipped with the Whitworth drive. They have been redesigned and converted into reversing motor drive, each head being provided with an individual 20-hp. reversing motor which furnishes power for driving the slotting rams. Each of the heads has a cross rail on which the cutter bar saddle is traversed across the machine. The machines as rebuilt are provided with modern electric power feed, each head having its individual 7½-hp. motor which also furnishes power for rapidly traversing the head on the cross rail and the housing on the bed. The bed is 7 ft. wide and 50 ft. long and there are three slotter heads which span its working surface.

One of the important features of this machine as it has been rebuilt is the provision made for slotting at any angle. The saddle can be traversed along the cross rail and the housings traversed along the bed in either direction with both feeds engaged at the same time, having independent adjustment providing for slotting at any angle desired.



Triple Head Locomotive Frame Slotter Redesigned and Rebuilt by the Betts Machine Company

By changing the machine over to reversing motor drive with electric feed and modernizing the machine, an increase of at least 25 per cent in output is said to be obtained.

Angle Compound Steam-Driven Air Compressor

THE new air compressor illustrated is made in capacities from 1,000 ft. up by the Sullivan Machinery Company, Chicago, and represents the latest type of compressor developed by this company. It is a single steam cylinder machine of the modern four valve type in which the steam travels in a direct path from inlet to exhaust, and in which initial condensation is said to have been largely eliminated. Some original and peculiar advantages are embodied in the design in conjunction with the angle compound principle which has been so successful in compressors of the belt-driven and direct-connected types during the past ten years.

The steam valve gear side of the machine is illustrated in Fig. 1 which shows the single high duty steam cylinder placed in the rear of and in tandem with the low pressure air cylinder, the high pressure air cylinder being in a vertical plane. A heavy fly wheel, better shown in Fig. 2, is mounted on one end of the crank shaft so as to impart a smooth and even motion to the machine. A single crank pin drives both low pressure and high pressure pistons. All moving parts of the compressor proper are provided with positive automatic lubrication.

The low pressure cylinder is directly attached to the main horizontal frame, the other cylinders being supported and firmly bolted in correct alinement with the main frame.

The main bearings are made in four parts of cast-iron lined with babbitt and arranged for ready adjustment and removal without taking out the main shaft. The steam cylinder is of the Sullivan high duty type. The cylinder casting contains the exhaust ports, placed near the bottom of the bore, and at some distance from the cylinder ends. The cylinder heads contain the steam ports into which the steam valve cages are pressed. The entire head is utilized as a reservoir for the steam so that the head temperature is the same as that of the steam entering the cylinder. The admission ports are placed at the bottom of the heads and extend below the bore of the cylinder to permit any condensation entrapped after the exhaust valves have closed, to escape into the head. The steam cylinder is lined with 85 per cent magnesia and sheet steel.

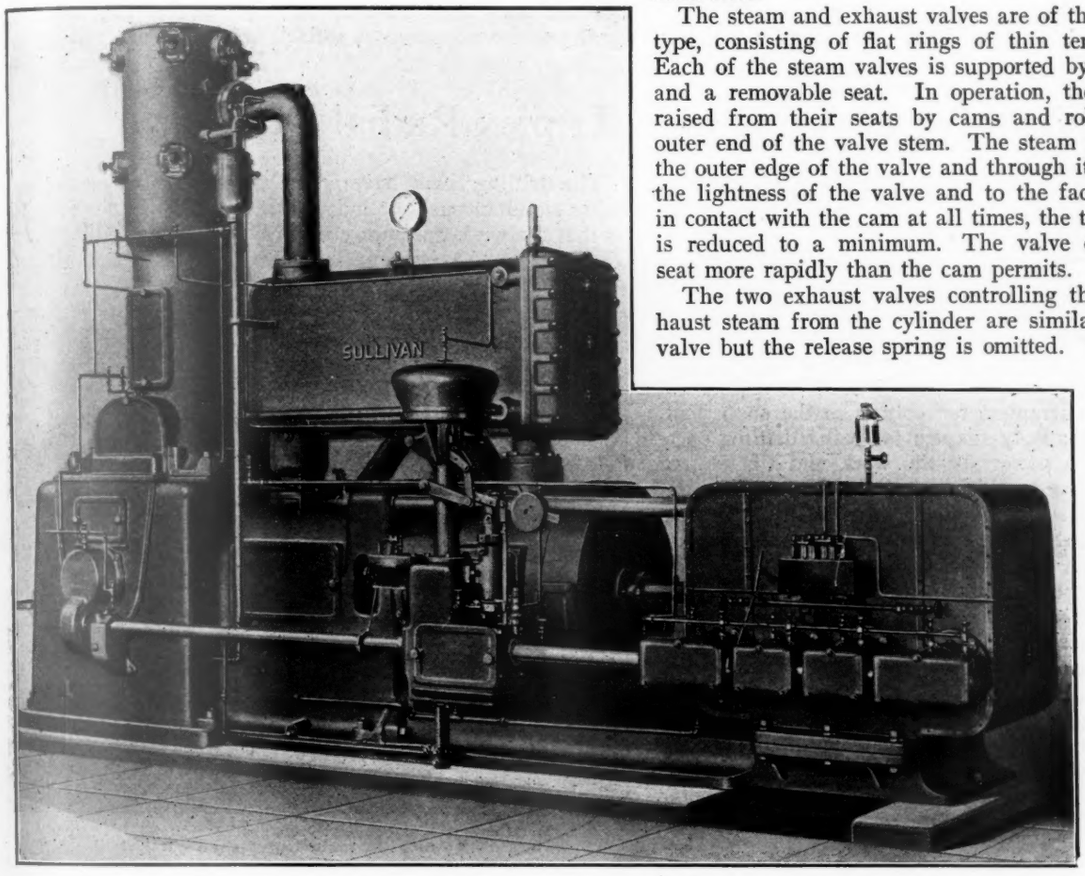


Fig. 1—View Showing Steam Valve Gear Side of Sullivan Air Compressor

The steam and exhaust valves are of the Sullivan "wafer" type, consisting of flat rings of thin tempered alloy steel. Each of the steam valves is supported by a fore-arm spider and a removable seat. In operation, the steam valves are raised from their seats by cams and rollers acting on the outer end of the valve stem. The steam is admitted around the outer edge of the valve and through its center. Owing to the lightness of the valve and to the fact that the roller is in contact with the cam at all times, the tendency to hammer is reduced to a minimum. The valve cannot move to its seat more rapidly than the cam permits.

The two exhaust valves controlling the discharge of exhaust steam from the cylinder are similar to the admission valve but the release spring is omitted. The steam and exhaust valves are operated by cams acting against the rollers mounted on the outer ends of the valve stems. These cams are set on a motion rod running the entire length of the compressor and deriving its motion from the crank-shaft by means of spiral gears. The operation of the valves is controlled through this rod by the speed and pressure governor.

The inlet and discharge valves on both low pressure and high pressure cylinders are of standard wafer design, consisting of plain flat rings of special alloy steel resting on carefully ground seats of the same shape. These valves are fully automatic, being held to their seats by air pressure and returned after opening by the flat helical springs.

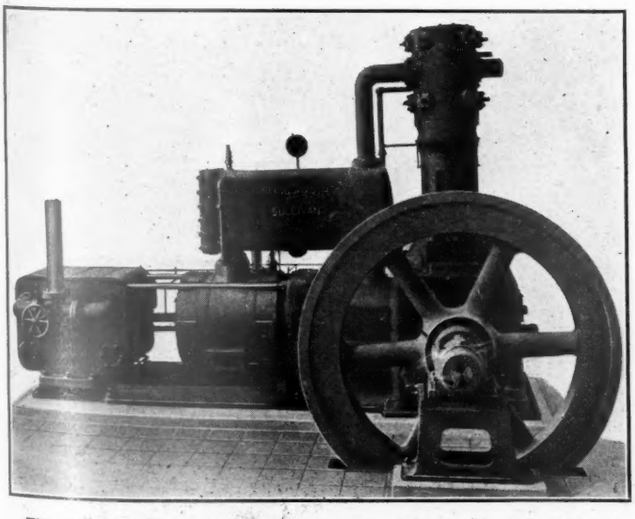


Fig. 2—View from Opposite Side Showing Heavy Fly Wheel

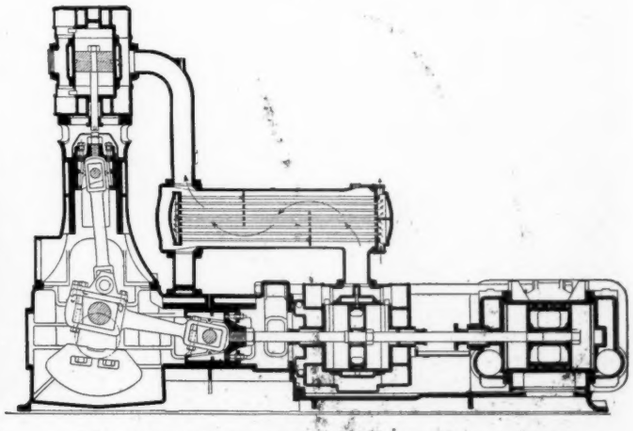


Fig. 3—Section Through Center Line of Compressor

The intercooler for removing the heat of compression in the air discharged from the low pressure cylinder (see Fig. 3) is a substantial cylindrical cast-iron shell designed to

contain an amount of cooling surface sufficient to produce thorough cooling of the compressed air. It is located immediately over the low pressure cylinder and frame as shown.

The inner cooling surface consists of a nest of copper or aluminum tubes through which the cooling water circulates entering at one end, traversing one-half of the tubes and returning through the remainder. By removing the bolts securing the outer header the whole nest of tubes with the header may be withdrawn for inspection and repair.

The crank shaft bearings, crank and crosshead pins and crosshead guides of both high and low pressure rear end members are provided with stream lubrication. The air cylinders and steam cylinders are oiled from a two compartment positive oil pump at a fixed speed.

Portable Universal and Triplex Radial Drills

SEVERAL types of radial drilling machines of improved modern design have been developed by William Asquith (1920), Ltd., Halifax, England. These machines include a portable universal radial drill illustrated in Fig. 1, a 7-ft. and an 8-ft. central thrust elevating arm boiler shop radial, and a triplex radial drilling machine illustrated in Fig. 2. The first machine is made in two sizes of 4 ft. 9 in. and 5 ft. 9 in. radius respectively. A traveling bogie is usually provided as shown in the illustration but if required, a special base can be arranged for bolting to the shop floor. The machine is particularly adapted for boiler drilling operations, having ample power for the work and the desired range of feeds and speeds which are easily controlled.

Six changes of speed are available from 41 r.p.m. to 300 r.p.m. through a three-speed gear box and double gear on the drilling head. A special reversing motion enables taps to be withdrawn at approximately three times the speed of insertion, this quick reversal being obtained automatically without changing the speed in the gear box. The radial arm can be traversed across the column easily by means of a hand-wheel; it can also be elevated on the column by either hand or power. Secure locking devices are provided for each of these movements. The column is of strong section, being fitted at the top with a plug carrying the lifting hook. Drive is by means of a 3 hp. self-contained reversible motor mounted on the arm end plate through a single pulley and gear box.

The triplex radial drilling machine, illustrated in Fig. 2, consists of three radial units and is employed to advantage for drilling holes in boiler fireboxes and similar work. A pit is arranged at the front of the bed to accommodate the larger boilers and other deep objects.

The drilling heads have power adjustments along the bed either simultaneously or independently in the same direction so that the work does not need to be moved after the initial setting. On this machine locomotive frames can be drilled in sets. One or more frame plates are accurately marked out and checked, being then used as jig plates for the remainder of the frames. When work is arranged on both sides of the bed the drilling heads can be kept continuously engaged.

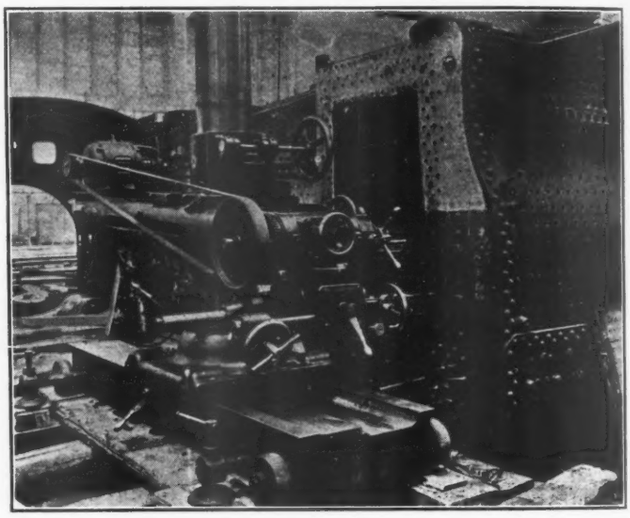


Fig. 1—Asquith Portable Universal Radial Drill

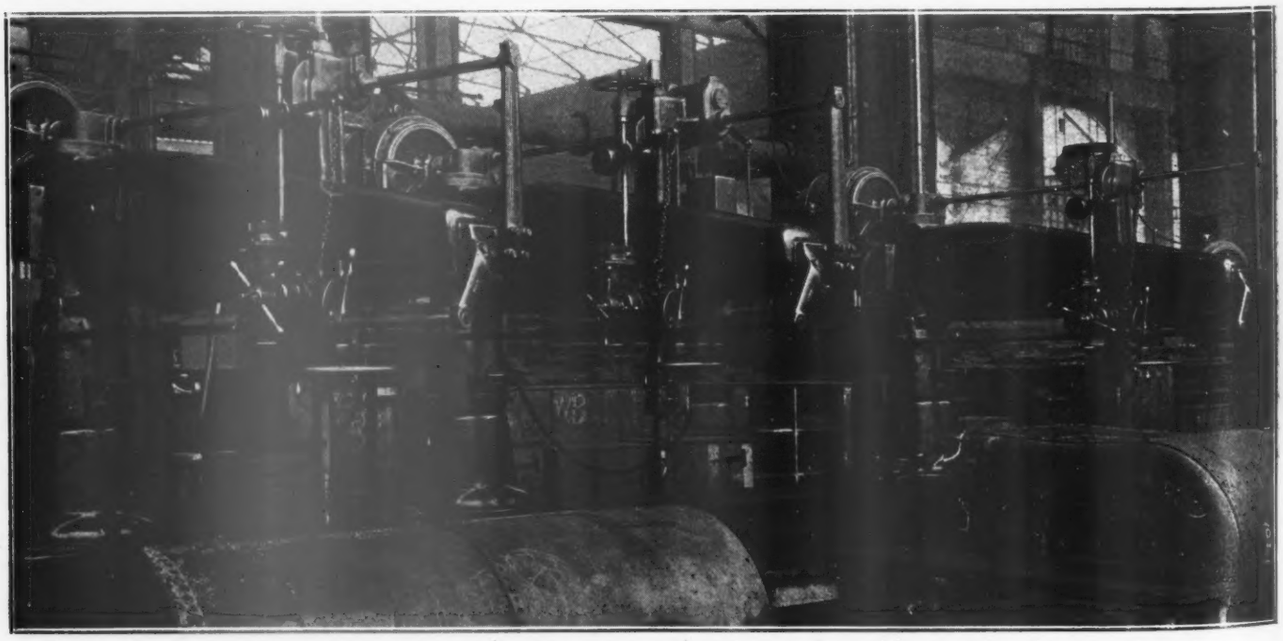
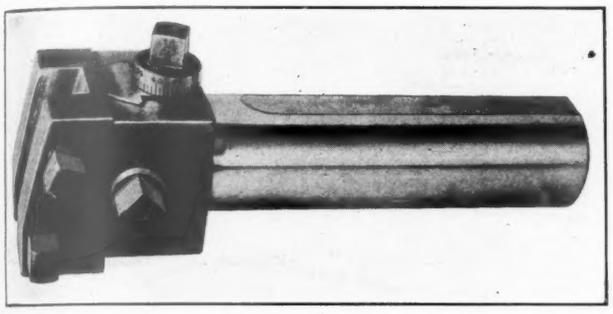


Fig. 2—Asquith Triplex Radial Drills Expedite Boiler Shop Drilling Operations

Accurate Cutter Holder for Turret Lathes

AN adjustable angle cutter holder for turret lathes has been designed by the Warner & Swasey Company, Cleveland, Ohio, eliminating guess work when adjusting the cutter to close limits. When turning to accurate size with a cutter head, at least two cuts must be taken over the surface. The roughing cut should be held to a limit of



Warner & Swasey Turret Lathe Cutter Holder

±.004 in. This can easily be done with a common holder by tapping the cutter lightly with a hammer. The finishing cut, however, requires considerable skill and some luck when using the common cutter holder to prevent moving the cutter too far and thereby spoiling the work.

With this new adjustable angle cutter holder guess work and luck are eliminated. A graduated adjusting screw operates a small but rigid cutter slide. The screw adjusts the cutter easily and accurately so that a limit of less than .001 in. can be held. The head is made of hardened steel throughout and a series of severe tests were made to demonstrate its rigidity. After a finishing cut had been taken, the cutter was allowed to bump into the previously rigid shoulder of the work. No variation in the diameter could be detected in the next piece.

When in use the lock screw is drawn up lightly and kept in that position so that adjustment can be made without changing the tension of the screw. An adjustment as small as one half-thousandth of an inch is possible. In addition to obtaining the original setting easily and quickly, the exact size can be maintained as the cutting edge wears and the machine warms up through the day's run. Cutter wear takes place especially on the first few pieces machined immediately after grinding the cutter. By use of this tool production can be increased as it takes much less time to adjust the machine which is, therefore, in actual use a greater length of time. There will also be less chance of turning work undersize where this cutter holder is used.

Flexible Gasoline Power Lift Truck

A GASOLINE power-elevating platform truck, embodying many unique construction features and known as the Clark Truklift has been placed on the market by the Clark Trucktractor Company, Buchanan, Mich. The new truck conforms in appearance and uses to the electric

Clark Truklift with Power Elevating Platform and Compact Gasoline Motor Drive

elevating lift trucks which have been used in industrial plants for many years. Low initial cost, ease of maintenance, flexibility and continuous twenty-four hour service are distinguishing characteristics claimed for it by the builders.

The loading platform is 26 in. wide by 54 in. long and will elevate its load of 4,000 lb. from a minimum of 11 in. to a maximum of 16 in. from the floor in eight seconds; automatic stops provide for both up and down limits; elevation can be stopped by the hand control lever at any point in the travel.

The lifting mechanism is operated by hydraulic pressure. Power for locomotion and elevating the load is derived from a 15-hp. four-cylinder tractor engine with 3⅛-in. bore and 4½-in. stroke. The engine is mounted at the rear in a closed compartment containing transmission, governor, vacuum tank, radiator, etc.

A three-point suspension is used, the steering wheel forks being supported in a steel casting which is pivoted at the center of the frame on a chrome-nickel steel pin 2 in. in diameter. The drive is through a Clark bevel gear axle equipped with ball and roller bearings and located under the loading platform. The driving wheels are of cast steel with pressed-on rubber tires 10½ in. by 5 in. The steering wheels are of cast steel disc type with pressed-on rubber tires 16 in. by 3½ in. Standard automotive construction has been adhered to wherever possible so that the Truklift can be repaired by any good automobile or truck mechanic. A hinged hood renders the engine available for inspection instantly and if necessary the machine can be stripped down to the chassis in less than 20 min., which expedites any repairs that may be needed.

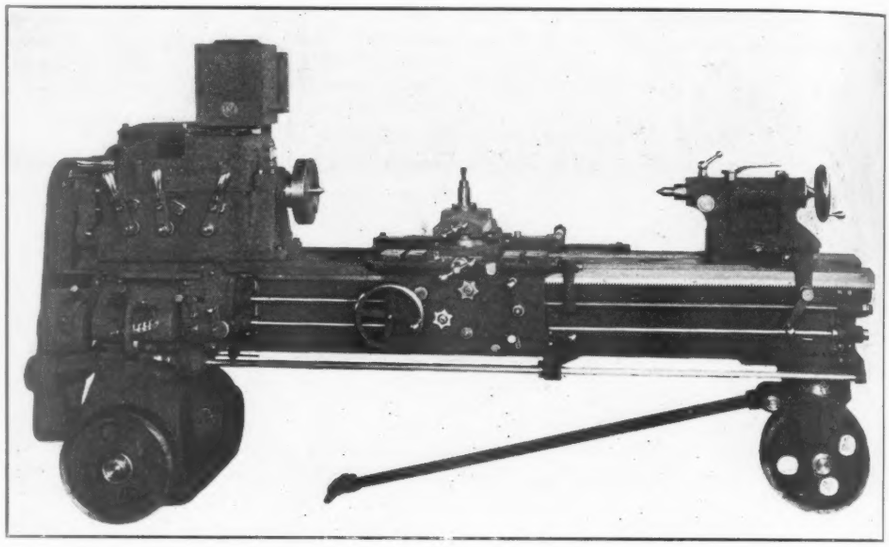
The driving and elevating controls are mounted on the rear of the engine compartment and are operated by the driver who drives standing. The brake lever pedal is under the driver's foot and so arranged that the Truklift stops automatically if for any reason the operator steps off while the machine is running. The machine will climb a 10 per cent grade with a 4,000 lb. load and has two speeds in each direction. The total weight is 2,500 lb.; overall length 107 in.; width 35½ in., and height 51 in.

Portable Geared Head Engine Lathe

THE Lehmann Machine Company, St. Louis, Mo., has just brought out a geared head engine lathe in the portable type, especially adapted for railroad and other shops doing large work where it is necessary to bring the tool to the job. This lathe, which is built in two sizes with 16 in. and 18 in. swing respectively, is direct motor-driven through a belt and idler, an 1,800 r.p.m. motor being used. This motor is light and compact, being mounted in the cabinet of the leg at the head end of the lathe. The pulley and belt and other working parts are fully covered and protected with suitable guards.

The headstock gives 16 spindle speeds in almost geometrical progression with the use of only 10 gears, all of which are heat treated and of a special grade for the purpose. The headstock forms an oil tight case enclosing all running parts. All shafts in this headstock run on ball bearings with the exception of the spindle which is of alloy steel, hardened and runs in phosphor bronze bearings amply lubricated. The spindle nose has two diameters, both hardened and ground, giving two bearings for the face and chuck plate, one in front and one behind the threads on the spindle nose. Forward and reverse revolution of the spindle is obtained through patent friction clutches, running in oil with control handles conveniently located one at the apron and one at the head end of the lathe. The clutches require no adjustment at any time and are designed to pull a little more than the load imposed.

In addition, these lathes include other Lehmann features, such as the patent quick change mechanism, tailstock spindle locking device, rod and screw shift, etc., which have been described at various times in the *Railway Mechanical Engineer*.

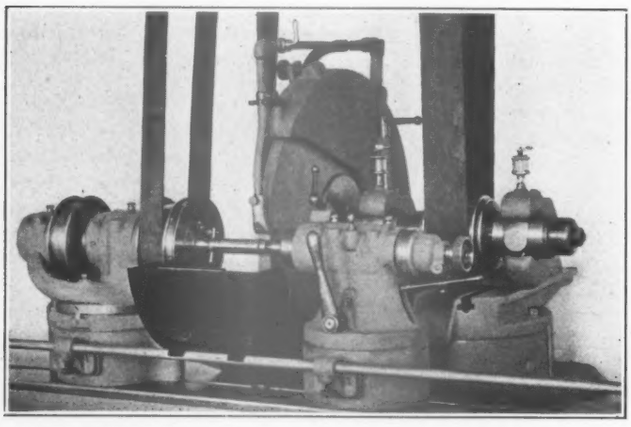


Lehmann Portable Lathe with Compact Motor Drive Arrangement

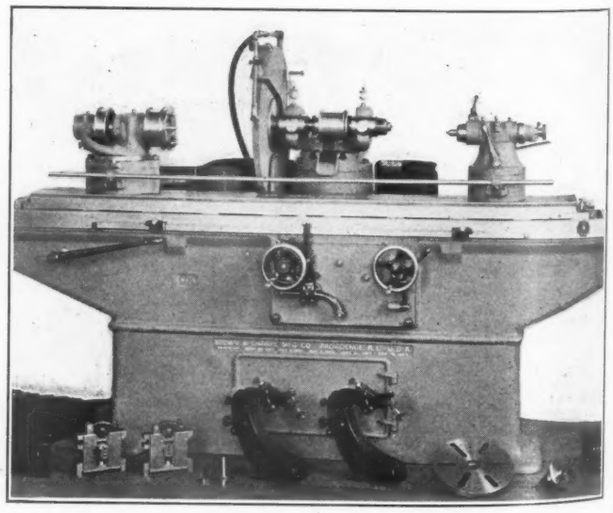
Universal and Crankshaft Grinding Machine

A NEW grinder, known as the No. 4 universal and crankshaft grinding machine, has been developed by the Brown & Sharpe Manufacturing Company, Providence, R. I. It is primarily a universal machine, but adapted to the grinding of crankshafts. Raising blocks under the headstock and footstock and a wheel of large diameter, also special throw-blocks adapt this machine for crankshaft work. The fact that it is a universal machine enables it to do a large variety of work, including straight cylindrical grinding and the grinding of abrupt tapers. With the tool rest, it grinds cutters and reamers, boring bars and other tools. The advantages this machine possesses over previous models lie in the wider range of work it will cover. With the internal attachment and tool rest illustrated, it is capable of all the work done by previous models and is also adapted to grinding all automotive parts except cylinders en bloc.

The No. 4 grinder has a capacity to handle work 60 in.

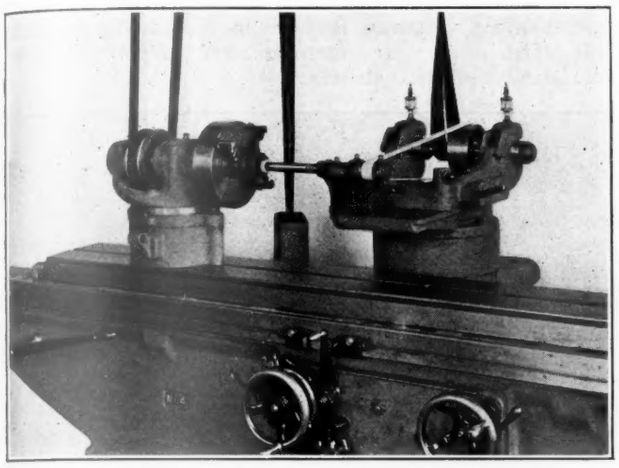


Typical Set-Up for Grinding a Small Pin



Brown & Sharpe Universal and Crankshaft Grinding Machine

in length with a swing of 20¾ in. in diameter and 15½ in. over the water guards. The wheel spindle has hardened



Arrangement for Internal Grinding

bearings ground and lapped, running in self-alining phosphor bronze boxes provided with means of compensation for wear. The automatic cross feed will move the wheel from .00025 to .004 in. at each reversal of the table as desired. It is automatically disengaged when the work is to size. The table travel is automatic, being controlled by easily adjustable dogs. The speeds and feeds of the wheel and work and table feed are entirely independent of each other. A single lever starts and stops the rotation of the work and the feed of the table. The table reversing mechanism is said to be accurate, allowing work to be ground close to shoulders.

The base of this machine rests on the floor at three points, thus maintaining the alinement of the table. The box-like construction of the frame with the ample overhang at each end (not shown in the illustrations) gives firm support for the table, especially at the end of its traverse. The grinding wheel is 24 in. in diameter, 1 in. thick and has a 5-in. hole. It is amply protected by a heavy guard which helps to confine the spray and particles of abrasive. The footstock carries a holder for the carbon point and the wheel can be trued without removing the work from the centers.

Two universal back rests are included for supporting slender work or splined shafts. These rests are universal in all movements, being capable of delicate adjustments and automatically compensating for the decrease in diameter as the work approaches the size. For wet grinding there is an abundant supply of water furnished by a pump. Telescopic water guards included in the equipment effectively protect the operator from spray. The floor space required for this machine is 52 in. at right angles to the spindle and 207 in. parallel to it. The hollow base is fitted as a closet to hold small tools and accessories.

Positive Self-Opening Stud Setter

THE Geometric Tool Company, New Haven, Conn., has developed a self-opening stud setter, made in two styles, positive and friction, and known as the Jarvis self-opening stud setter.

Parts of the positive type stud setter are shown in Fig. 1 and the assembled tool in Fig. 2. The parts consist of shank *A*, body *B*, cap *C*, jaw holder *D* and jaws *E*. The method of assembling these parts will be evident from the illustration.

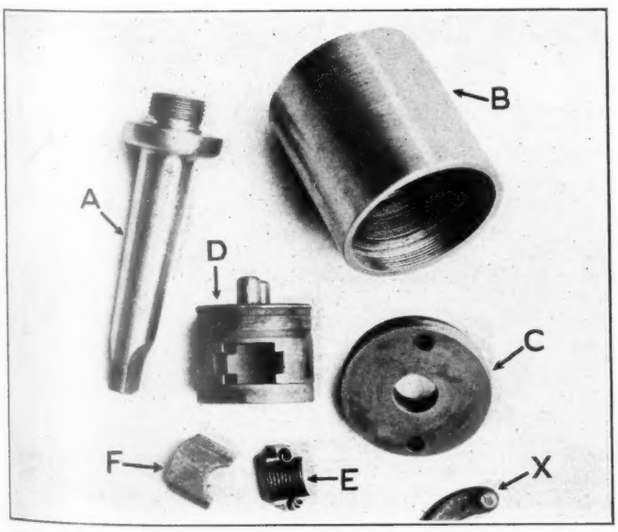


Fig. 1—Parts of the Jarvis Self Opening Stud Setter

Shank *A* is attached to body *B* which drives the jaw holder *D* through two hardened steel pins. The jaws *E* are a sliding fit in jaw holder *D* and are forced together when setting the stud by stops on the inside of *B*. When the direction of rotation is reversed the stud setter releases and may be removed. The stud is not driven by friction on the threads but bottoms against a steel pin in the jaw holder *D*.

The grip on a ½-in. stud is about ½ in., larger sizes being slightly more. The gripping action is substantial. When the positive style stud setter is used it is necessary to have a stop collar around the stud to serve as a stop and release the jaws when the stud reaches the bottom. The stop on the spindle of the drilling machine will serve for this purpose. There is a downward travel of about 1/16 in. in the jaws necessary between the instant when the stop is met and that in which the jaws will release. For this reason, particular care must be taken in the adjustment of the stop collar so that the jaws will release the stud the instant it is at the bottom. Otherwise damage will result.

A friction style stud setter also is provided, the stop collar in this case being unnecessary. With this type of tool a large cone friction on top may be adjusted by manipulation of

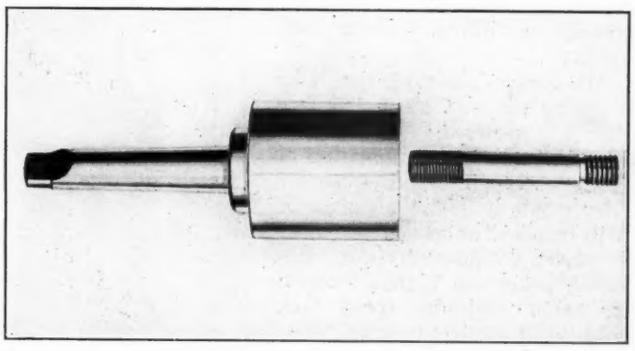


Fig. 2.—View of Assembled Stud Setter and Stud

lock nuts. When the stud being set reaches the bottom the proper adjustment of the friction will allow it to slip, at which time the operator by a quick upward motion of the feed handle releases the jaws and frees the stud. Three sizes of stud setter are regularly listed with capacities from 0 to ½ in., 0 to ⅞ in. and 0 to 1½ in. A fourth size also is now furnished on special order with a capacity from 1 in. to 2 in.

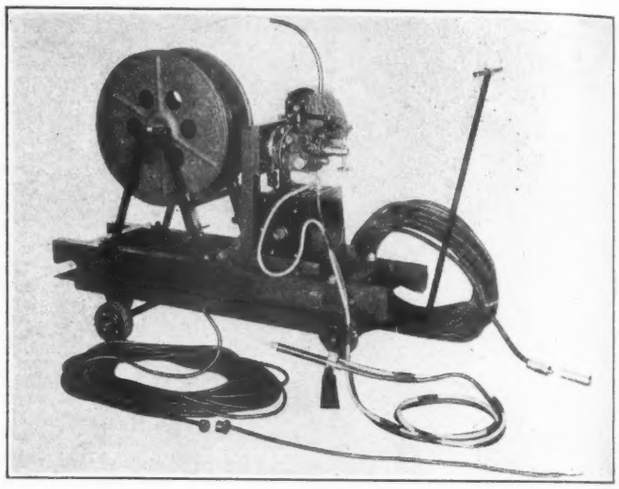
Portable Semi-Automatic Arc Welding Set

In order to increase the applicability of its semi-automatic arc welding apparatus, and adapt it for use in any place where current for welding is available, the General Electric Company is now building a portable set. This comprises a complete semi-automatic equipment, with support for a wire reel, mounted on a small truck that can be pulled over the shop floor by hand, or lifted by a crane. The complete outfit weighs about 400 lb.

The welding equipment consists of a semi-automatic lead, an automatic welding head, with control, and a standard for holding a reel of electrode wire. Power is supplied to the arc through a flexible cable with a plug for attaching it to the nearest welding circuit. The reel carrier is equipped with a brake and designed to take any size reel up to 2½ ft. in diameter.

The portable outfit should be valuable in repairing parts of machines in place when these parts are too bulky, inconvenient, or otherwise impractical to move, and for doing routine welding of all sorts, such as filling holes in castings, welding seams in pipes or tanks, or other work of a similar nature. Besides the saving in time and trouble due to the portability of the outfit, its use will save both time and material in welding.

The electrode is fed continuously, the number of interruptions are reduced and less skill is required by the operator to make a good weld than is the case with ordinary hand welding. Material is saved by eliminating the waste ends which usually amount to at least ten per cent of the total amount of electrode wire used.

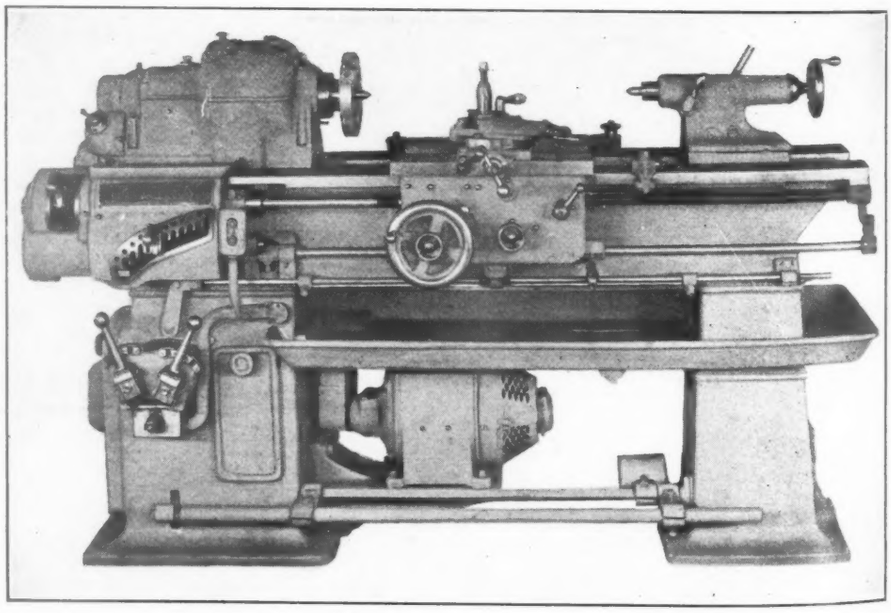


The Set Can Be Used Wherever Welding Current Is Available

Novel Motor Drive for Tool Room Lathe

An unusually interesting feature of the new 14-in. tool room lathe, developed by the Hendey Machine Company, Torrington, Conn., is the location of the driving motor under the oil pan as shown in the illustration. This is one of the most compact arrangements that it would be possible to devise, the lathe not requiring any additional head room or floor space due to the fact of its being motor driven. The lathe retains the desirable features of the cone type lathe and most of the advantages of the gear-type. Half of the spindle speeds are obtained through belt drives, an arrangement tending to provide flexibility, power and rigidity.

All motive parts of the lathe excepting the lead screw and face plate are enclosed. In construction, the lathe is a combination of readily accessible and generally independent units. The motor is easily reached or moved and does not obstruct light and vision. Reducing gears are placed between the motor and the speed box, which is in the left pedestal. The interior of the head, speed box, and quick change gear box may be conveniently exposed by hand holes or cover plates.



Hendey 14-In. Tool Room Lathe with Driving Motor Under Oil Pan

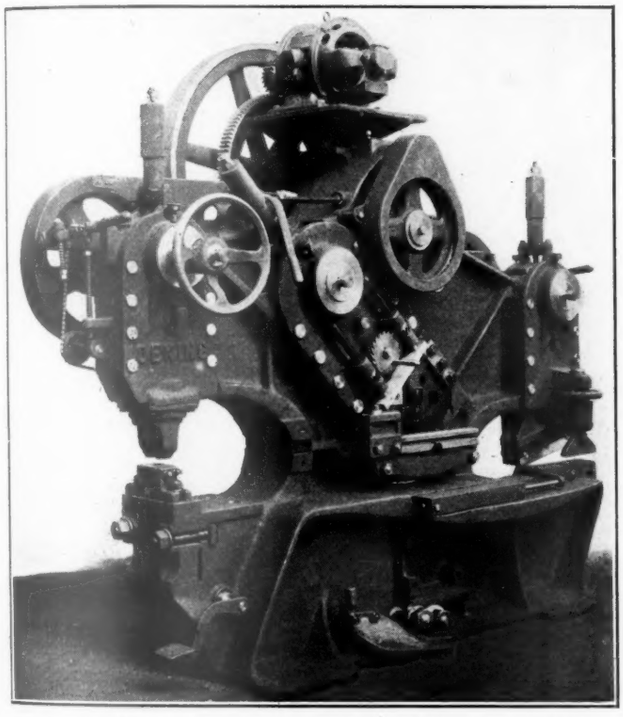
The head stock is equipped with the usual Hendey taper spindle and bearings with several distinctive features added, including the method of taking up end play on the spindle; construction of single pulley and pinion running on a sleeve readily supplied with oil; operation of the intermediate sliding feed gear by conveniently located eccentric levers; oiling of the back gear quill while in motion; enclosing all moving parts of the headstock except the spindle nose, thus protecting the operator and machine from injury.

Eighteen speed changes are obtainable, nine being direct through a belt to the spindle and nine through the customary back gears. The speed change mechanism is contained in an oil tight box. Maximum and minimum belt tension may

be instantly obtained by a single screw adjustment. The carriage and compound rests are of new design, providing maximum rigidity and convenience. The tailstock also is improved in the graduation of the spindle and the method of clamping. Motor control is by means of push buttons. By an interlocking method between the shifting levers and starting panels the speed of an a. c. or d. c. motor may be automatically reduced while the gear shifts are made. Supplementary control of the spindle is obtained through a treadle running the full length of the bed, which by foot pressure instantly stops the spindle for examination of or calipering the work.

Triple Combination Punch and Shear

AN improved design of triple combination solid steel frame punching and shearing machine, marketed under the trade name Oeking, is being offered by Amplex, Inc., New York. It may be noticed in the accompanying illustration that the operator's side of the machine is clear of all encumbrances such as flywheels and driving gears, all of which are placed on the opposite side. A slanting centering slide to permit mitering cuts to be made without lifting the angle bar to be cut, has been provided. The plate shear knives are 13 in. long for the No. 16 machine and 16 in. long for the No. 20, as against the former lengths of 9 and 11 in. respectively. Ample room is provided behind the knives to avoid binding of the plates when being cut.



Oeking Triple Combination Punching and Shearing Machine

The punch is arranged for punching both the webs and flanges of structural shapes and the height of the throat is designed to accommodate broad-flanged Bethlehem shapes. The punch is provided with a lowering device to locate the center mark before punching and both hand and foot levers are provided for throwing the machine into gear. The springs and gears have safeguards.

The bar and angle cutter is for any shape of structural material, but the standard equipment is for rounds, squares, angles and tees only. Knives can be conveniently changed for cutting beams and channels.

The frame is of cast steel; also the slides, which are adjustable. The covers of the slides are attached to the body by pin bolts ground to fit in position, a feature intended to prevent the covers from working loose. The bearings are designed to have ample surface, are bronze-bushed and provided with ring lubrication. All gears are cut.

The machines are built in sizes from No. 13 to No. 32. The No. 13 will split ½ in. plates, cut 3½ in. angles and punch ⅞ in. holes in ½ in. material. The No. 32 will split ¼ in. plates, cut 8 in. by 8¾ in. angles and punch 1¾ in. holes in 1 in. material. Provision has been made for cranes, gages and other attachments, which are provided if required.

For a machine of its power and range of work the Oeking triple combination punching and shearing machine takes up unusually little floor space. It is motor-driven by means of a self-contained electric motor and consequently the machine can be placed wherever is most convenient in the blacksmith shop, boiler shop or steel car shop, irrespective of position of driving shafts and pulleys.

Rubberstone Car Flooring Stands Tests

A CAR FLOORING, sold under the trade name Rubberstone by the Junius H. Stone Corporation, New York, may safely be said to have passed the experimental stage in that a two-year test on a prominent eastern railroad has resulted in an order to equip 50 additional coaches. Rubberstone is a composition of vegetable and mineral rubber, asbestos fibre and cork, particularly designed to withstand the severe service of a flooring used in passenger coaches. This service is particularly severe due to continuous vibration and torsion which tend to cause flooring of hard consistency to crack. If a soft flooring is used on the other hand the wear is excessive which is equally objectionable.

According to the tests referred to Rubberstone is not subject to the objections of either of the above types of flooring as it does not crack under stress of car motion nor does it show localized wear to any appreciable extent under exacting service conditions.

The new flooring is furnished in tile form, 12 in. by 24 in., and 12 in. by 12 in., in two thicknesses, ⅛ in. and 3/16 in. The available colors are brown, terra-cotta, olive green and black. The method of laying is to cover the floor area with a plastic water-proof cement into which the tiles are set. The cement not only holds the tiling down in a permanent grip but seals the joints rigidly. Filling the joints of the tile with plastic composition makes it a continuous one-piece flooring.

The characteristic feature of Rubberstone is said to be its self-healing ability. Abrasions, dents and even deep cuts are ironed out by traffic. When long and continuous traffic has caused wear it may be immediately restored to its original thickness by an application of the plastic

composition to the worn parts. Patches of this kind are said to bond perfectly to a feather edge and be invisible.

An important feature is the speed with which Rubberstone sets. Coaches floored with this material may be put into service 24 hrs. after laying the floor. Where patches are applied the composition solidifies in a few hours. Rubberstone is said to be highly fire resistant and matches and lighted cigarettes dropped on it will not cause it to burn. It is also waterproof and can be washed with any cleaning agent and hose without injury. This feature together with its close texture and the absence of open joints render it sanitary to a high degree.

Polyphase Motor With Unique Ventilating System

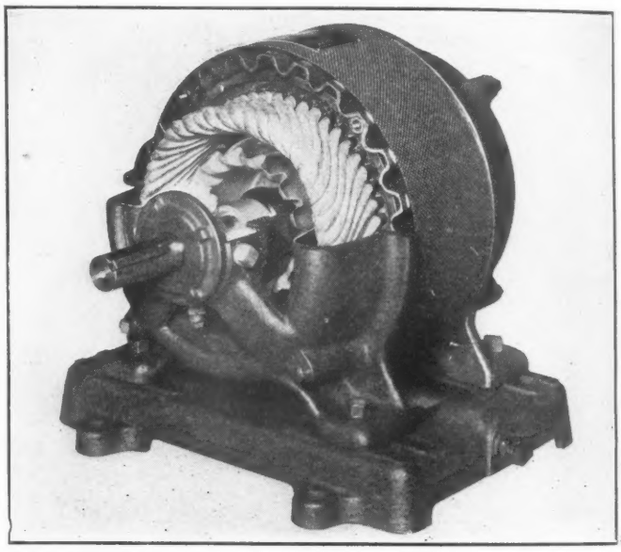
A LINE of polyphase induction motors has been brought out recently by the S. A. Woods Machine Company, Boston, Mass., so designed as to prevent the accumulation of oil on the motor windings and the resulting collection of dirt. The new Woods semi-enclosed 40-deg. induction motor, as it is known, is so built as to screen the ventilating air before it enters the windings and direct this air so that it opposes the entrance of oil into the windings from the waste-packed bearings. The waste-packed oiling method has been adopted also to overcome any tendency toward the spilling of oil when vibration is particularly severe.

While the motors are ventilated, or air-cooled, they are virtually enclosed from a mechanical standpoint. Air enters at the periphery of the machine and is discharged at both ends, the direction of air flow being opposite to that found in most motors. It is claimed that oil leakage caused by the careless filling of bearings cannot occasion bad results, because such oil is expelled from the ends of the motor instead of being driven into it.

The motor frame or casing is made from a single piece of corrugated sheet steeel. The corrugations are equally spaced and in mechanical contact with the stator core, so that much of the heat generated in the core and its winding is conducted to the casing, which therefore forms a large surface for the radiation of heat to the ventilating air.

Air entering at any point along the surface of the screen travels over the outside of the corrugations through holes provided at the center of these corrugations, then through the lateral ducts between the casing and core, then over the windings at the end, and finally is discharged at each end of the motor.

Fans are provided at the ends of the rotor for the purpose of drawing the cooling air through the machine. They are of unique design and it is claimed that a stream of air is drawn directly over the bearing housing and immediately expelled without entering the motor, while another stream is drawn through the machine and expelled at the same points. These fans are made of a single piece of sheet steel welded to the thrust collars. Rotor windings are used which have bars and end rings made of one piece of metal, entirely eliminating mechanical or electrical joints, the windings being molded or cast on the magnetic core. The motors are built in size up to 30 hp. at 1,800 r.p.m. for 60-cycle polyphase circuits with corresponding capacities at other standard speeds and frequencies.



Ventilating Air Is Reversed to Keep Oil Out of the Windings

Superspeed Sensitive Drilling Machine

THE latest addition to the line of drilling machines made by the Fosdick Machine Tool Company, Cincinnati, Ohio, is a new superspeed sensitive drill. It is built in two types, bench and pedestal, and in combinations of from one to eight spindles. The capacity is for drills up to ¼ in. in steel, iron or brass. With the driving pulley operating at 1,750 r.p.m. three spindle speeds of 5,700, 8,000 and 12,000 r.p.m. are available; other speeds to suit conditions may be substituted.

All revolving members are equipped with annular ball bearings, and dust-proof metal oil retainers, the only revolving member exposed being the drill chuck. A spiral gear drive tends to eliminate vibration and noise, and in combination with the flat endless belt reduces the danger of drill breakage at maximum speeds.

The outstanding feature of the new drill is the speed changing arrangement, by which a single turn of a handle automatically releases the belt tension, shifts the belt first from the larger to the next smaller step on one cone pulley, followed by a similar movement from the smaller to the next larger step on the other cone. The belt tension then automatically adjusts to the new position. An aluminum guard which completely encloses the belt and cone pulleys may be lifted off without removing or loosening bolts or nuts, thus enabling the operator to install a new belt quickly.

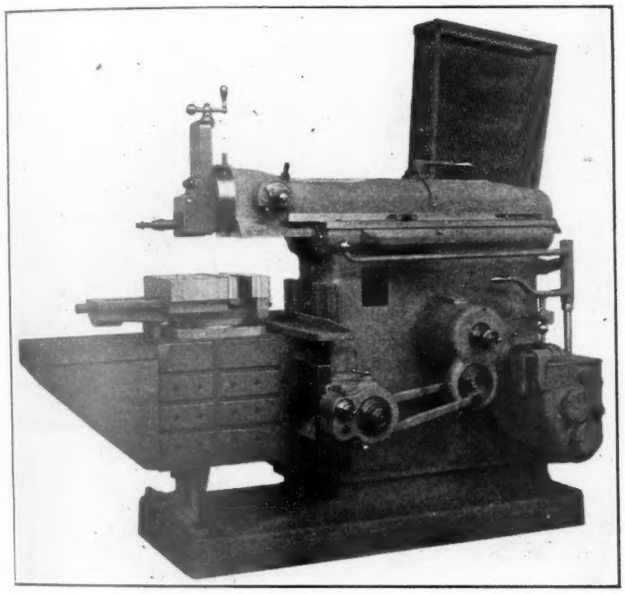
In the pedestal type machine an unusually large floor area is noticeable. The elevating table is of the quick acting, counterbalanced type, with the clamping handle in front. The traverse is 10 in. Both the elevating and the bench tables are surrounded by liberal chip and lubricant channels. The head has a vertical traverse of 6 in., and is counterbalanced to prevent dropping when unclamped. The spindle feeds to a depth of 3 in. with a depth stop adjustable to any point within this range. It has an adjustable gravity counterbalance, devoid of springs, which may be readily set to automatically return the spindle.

The feed lever is adjustable to suit the operator's convenience. Opposite the feed lever is the quick return hand wheel, which enables the operator to position, feed, or return the drill with either hand. The adjustable belt guard and shifter will adjust to receive the belt from any angle. Motor drives are either belted or direct-connected, with a ½-hp. motor mounted on machine.

The regular equipment includes a No. 1A Jacobs improved drill chuck on each spindle. The single spindle type machine weighs 225 lb. and the pedestal type 464 lb.

Crank Shaper Featured by Extended Table

THE latest shaper design of the Hendey Machine Company, Torrington, Conn., is shown in the illustration. The extended table is a valuable feature of this machine which is designed for great durability, simplicity and convenience in operation. The machine has the capacity to handle 24 in. work and may be arranged for either motor or single pulley drive.



Hendey 24-In. Crank Shaper with Extended Table and Long Ram

As indicated in the illustration the machine is decidedly compact and self-contained, occupying a minimum of working space whether motor- or belt-driven. Bearing and rubbing surfaces are liberally proportioned so as to provide long life and accuracy and wherever practicable ball bearings are used to reduce the friction and power required for operation.

The ram is started by a sensitive lever conveniently located at the right of the operator. It can be stopped at any point in the stroke within one-half inch even while taking the heaviest of cuts. The ram is unusually long and well braced and because of its length and the design of the bearings is held in accurate alinement while working at maximum stroke. Wear is taken up by an improved single gib adjustment. The head is liberally proportioned, the head slide having a binder which may be used as a drag. Aside from the usual T-slots, the table of this machine has rows of jig-drilled and reamed plug holes at right angles to the edges of the table providing means for blocking and fastening work to the top or sides.

The cross feed is specially designed giving complete control and setting of feeds on the end of the crosshead, the control lever indicating the direction of table travel. The down feed is also patented and said to provide uniformly smooth and noiseless motion at all speeds. All levers and feed indexes are stationary.

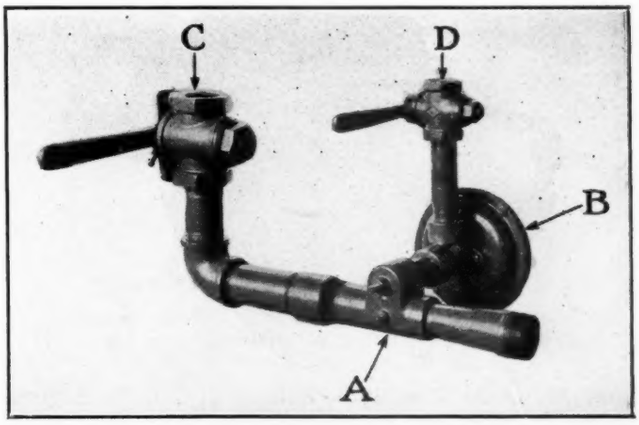
The driving pulley and gear shafts are mounted on interchangeable ball bearings, the gears being of alloyed steel, heat treated. The starting clutch and brakes are located with the pulley at the rear of the machine. Both crankpins and crank-blocks are of hardened steel ground on all wearing surfaces. The take-up of the crank-pin in the bolt gear center is by a single gib. The machine is designed with ample power and structural strength to stand up under the heavy cuts required in modern shop practice. The sturdy design makes it especially adapted for railroad work.

Surface Combustion Low Pressure Inspirator

DESIGNED for use on any make of gas furnace, the surface combustion, low pressure, air gas inspirator illustrated has been developed by the Surface Combustion Company, New York. This device uses the same principle and occupies an equally important position with the gas furnace as the carburetor does with the automobile. It operates on any fuel system in which air is available above ¼ lb. per sq. in. pressure and gas at pressures above one in. of water. The important features of the equipment are: (1) Automatic supply of the exact proportions of air and gas to the furnace needed under all conditions of operation. (2) The thorough and homogeneous mixing of the air and gas immediately prior to entering the furnace. (3) Instantaneous combustion. These features tend to secure the highest combustion efficiency and often effect fuel savings of 20 per cent over the usual two valve control systems.

The complete inspirator equipment consists of inspirator casting *A*, governor *B*, air cock *C* and gas cock *D*. The air line is connected at *C*, the gas at *D*, and the manifold piping from the open end of *A*. A water gage is installed at any convenient location on the manifold line to indicate pressure.

The entire operation of the furnace is controlled through the air cock. An increase or decrease of the air supply auto-



Low Pressure Air Inspirator Designed for Use on Gas Furnace

matically increases or decreases the gas so that the mixture proportions remain in a constant fixed ratio. The water gage indicates the rate of consumption, and enables the operator to reproduce accurately each day the most advantageous rate of operation. The gas cock is used only when starting or stopping and is either full on or full off. No adjustment of it is required. It is stated that explosive mixtures are impossible in any part of the distribution mains with this system. The gas and air are mixed only at the point of supply to the burners.

Hand or Power-Operated Differential Chuck

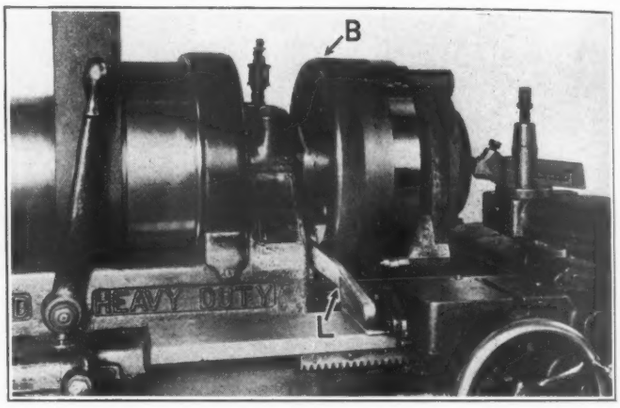
DESIGNED to provide greater holding power and speed of operation, a wrenchless type of differential chuck, as illustrated, has been developed by the E. Horton & Son Company, Windsor Locks, Conn. The advantages claimed for this chuck include a powerful grip obtained by differential gearing, quick and convenient wrenchless operation by hand or power, complete range for all sizes of work and simplicity of design.

To operate this chuck the knurled hand wheel *B* at the back is revolved until the jaws close to the work when the grip is tightened either by a quick push on the hand wheel or by starting the machine and exerting pressure on the lever *L*. To open the jaws, one quick pull on the hand wheel will release the grip and the jaws can then be run out to clear the work by a spin of the wheel.

The principle of operation is that of differential pinions operating with internal gears. The hand wheel carries five double pinions meshing with the backing gear and an internal gear of different pitch diameter than the backing gear. When the hand wheel is revolved the scroll rotates in the chuck with a powerful gear multiplication on account of the differential action due to this difference in pitch diameters. With the gear ratio as regularly furnished, one revolution of the hand wheel causes the jaws to move 1/32 in. radially, opening the chuck approximately 1/16 in. diameter.

An important feature is the device for locking and releasing the chuck. By allowing the backing gear a slight rotation on the pins which hold it to the body, a lost motion is imparted to the hand wheel. This lost motion furnishes a hammer action multiplying many times on the scroll the actual pressure applied to the hand wheel.

The lever *L* which is bolted to the machine, carries a friction shoe acting on the inside of the hand wheel. This is used, when power operation is desired, to hold the hand wheel stationary while the chuck revolves, thus affording great gripping power.



Horton Differential Chuck Designed to Speed Up Lathe and Other Chucking Work

Ball-Bearing Hanger Box and Pillow Block

RECENT additions to the line of ball bearing hanger boxes and pillow blocks, made by the Fafnir Bearing Company, New Britain, Conn., are the single ball bearing hanger box and self-alining, double ball bearing pillow block, illustrated. The former is similar in construction to the double ball bearing hanger box described in detail on page 325 of the May, 1921, *Railway Mechanical Engineer* except that only a single set of balls is utilized. This hanger box is a comparatively recent development designed for use on line shafts, light drives and machine applications. The box is said to be easy to install with no dangerous projections, bolts or screws. It is designed to give long service owing to the ball bearings running in hardened alloy steel races.

Fig. 1.—Fafnir Single Ball Bearing Hanger Box

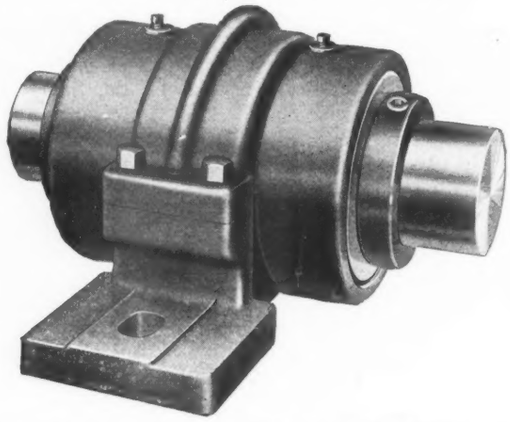


Fig. 2.—Self-Aligning Double Ball Bearing Pillow Block

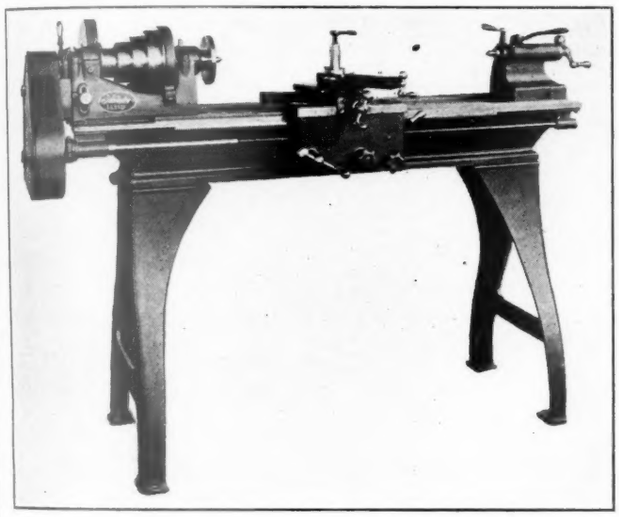
The pillow block is also provided with Fafnir transmission-type ball bearings, made from thoroughly treated alloy steel. Two ball bearings are provided. The inner ring of

each bearing is made an inch wide in order to give the bearing a firm seat on the shaft and afford the shaft extra support. A driving collar is mounted on the shaft at each end of the box and has lugs which engage corresponding slots cut in the wide inner ring. Consequently the shaft, collar and inner ring revolve as a unit and all end thrust is transmitted to the balls.

The driving collar and wide inner rings are exclusive Fafnir features. By this method, adaptor wedges and delicate adjustments are eliminated; the shaft is given ample support; and the bearing axis is held in accurate alinement with the shaft axis. It is also possible to mount each pillow block in an assembled unit containing no bolts or set screws in the housing. A special point of interest is the self-alining feature of the pillow block by means of which the bearing axis is held in accurate alignment with the shaft axis.

Small Screw-Cutting Engine Lathe

THE Seneca Falls Manufacturing Company, Inc., Seneca Falls, N. Y., has recently placed on the market a new screw-cutting engine lathe ranging in size from 9 in. to 13 in. swing and of the usual bed lengths. This machine is known as the "Handy" lathe, being a general purpose machine, arranged for either motor or belt drive. All the regular Star lathe attachments may be used in connection with it.



Handy Screw-Cutting Engine Lathe

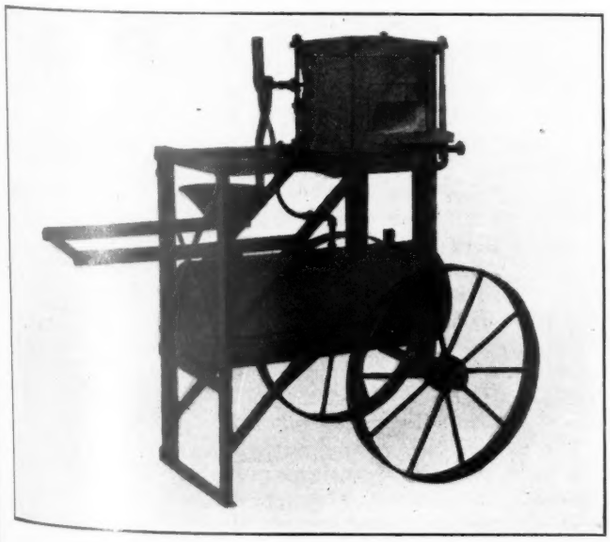
The Handy lathe is of heavy ribbed construction, equipped with either bench or floor legs. It is provided with back gears, power longitudinal and cross feeds, a large hollow spindle adapted to draw-in chucks, graduated cross feed screw, set-over tailstock, plain or compound rest, double friction countershaft with a cone belt shifter on the countershaft and self-oiling bearings. The lathe is said to be accurate, well designed and built of the latest construction to meet satisfactorily the exacting demands of modern machine shop practice.

This company is also placing on the market a plain turning lathe, having a 10 in. swing. 3 ft. bed, and taking 12 in. between centers. This lathe is equipped with a plain rest and feeds from .002 to .040 in. per revolution of the spindle are obtainable. A set-over tailstock, open belt, three-step cone and self-oiling spindle are provided. The countershaft is of the tight and loose pulley type with roller bearings in the loose pulley. This machine is brought out to meet the demand for a small sturdy plain turning lathe without the screw-cutting feature.

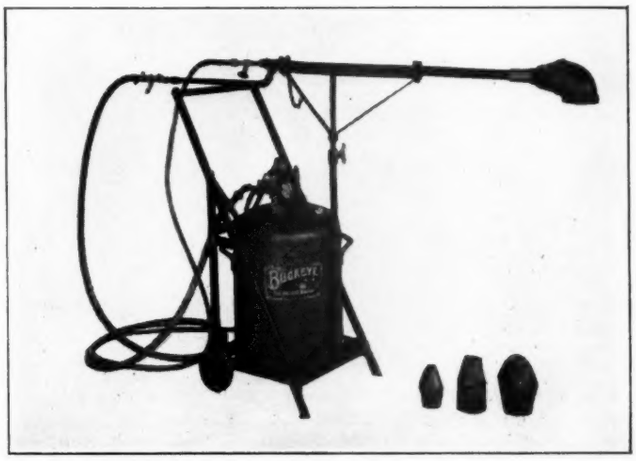
Rivet Forge and Oil Heater for Car Work

THE illustrations show a rivet forge of the suction type and an oil heater for steel car work manufactured by the MacLeod Company, Cincinnati, Ohio. The forge is built with a heating chamber made of special tile, the chamber being 11 in. by 7½ in. The oil is supplied from a 20-gal. tank and the outfit is mounted on a two-wheel truck that can be easily handled and moved from place to place. The rivet forge is built to endure rough usage and to support the heating chamber at the top. The opening is fitted with a blast pipe to keep the flame inside and protect the operator.

The forge operates with oil and compressed air. There is no pressure on the tank, the oil being sucked from the tank and sent to the burner in a steady, even flow by the vacuum



MacLeod Portable Suction-Type Rivet Forge



Oil Heater for Steel Car Work

tube, shown on the left side of the forge, to the back of the burner.

The burner shoots the flame into the forge on an angle, in such a manner as to cause a reverberatory action in the forge. In this manner the flame is prevented from touching the material to be heated and thus oxidizing the rivets.

The burner with the oil heater is supplied with four castings or nozzles, three of different sizes and one for work at right angles. The heater has a 17 gal. tank fitted with pressure gage and necessary fittings and is mounted on a two-wheel truck. The burner is supplied with two 12½-ft. lengths of air and oil hose.

The heater operates with compressed air and oil, either crude, fuel, kerosene or distillate oils. Operation is instantaneous; the outfit is attached to the compressed air line and the burner started. The mixing of the air and oil takes place in the mixing or combustion chamber which is just back of the nozzle or casing, the nozzle being simply to confine and direct the flame. The burner will give an intense, hot flame from 3 in. to 48 in. in length, making it suitable for a wide range of work.

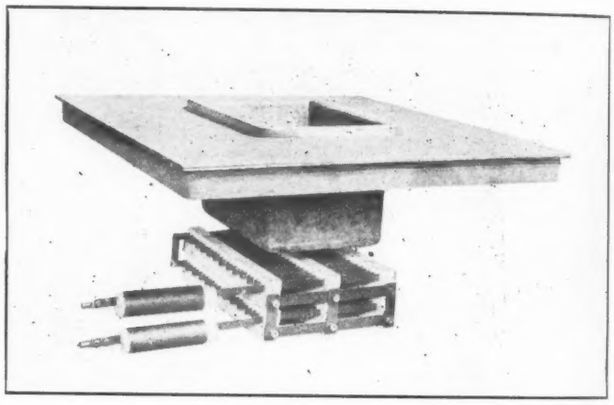
The shipping weight of the heater complete is 150 lb. and the light truck enables the outfit to be used either in the repair shops or in the yards.

Electrically Heated Babbitt Pots

TWO large size, high temperature, automatic melting pots have been developed by the General Electric Company for melting large quantities of babbitt, solder and similar alloys or metals. The two devices are similar in appearance and construction and consist of a pot, supporting plate, heating unit, insulators and an automatic control panel with a temperature control instrument.

The pot and supporting plate are made of gray cast iron. The heating unit consists of a nickel-chromium alloy ribbon, which is formed, equipped with terminals, and assembled on the insulators, which are made of a special compound.

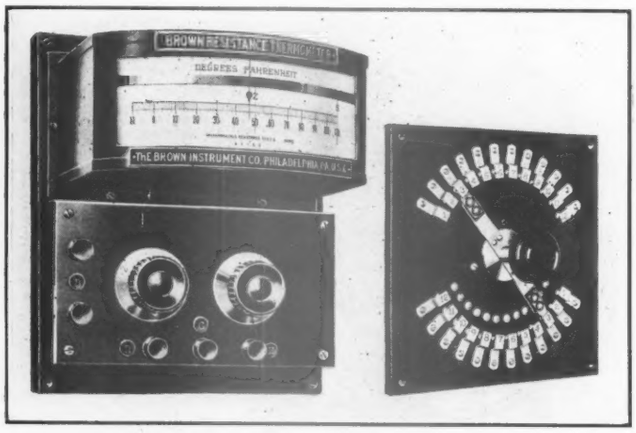
One of the pots will operate at temperatures up to 800 deg. F. in the metal to be melted, requires 10 k. w. of energy for operation, and is controlled by a Tycos mercury thermostat. The other pot will operate at temperatures up to 1,100 deg. F., and is controlled by a Leeds & Northrup single point potentiometer. The thermostat may be set for any desired temperature and will cut off the current at 5 deg. above the temperature and will close the connection again at 5 deg. below. Both of the pots have a capacity of 1,000 lb. of lead, 668 lb. of tin, or 920 lb. of babbitt consisting of 80 parts lead and 20 parts antimony. These pots are designed for use where larger quantities of material are needed at one time, when the temperatures involved are higher or a quicker rate of heating is desired than is possible with the smaller self-regulated pot manufactured by this company.



Electric Melting Pot Without Brick Housing

A Direct-Reading Resistance Thermometer

THE fundamental principle of the resistance thermometer, recently developed by the Brown Instrument Company, Philadelphia, Pa., is the well-known physical property of metals, except special resistance alloys, of change in resistance with change in temperature. This change in resistance can be accurately measured and a scale calibrated in temperature degrees.



Brown Resistance Thermometer and Rotary Switch

The bulb or coil of wire which changes in resistance is usually of nickel for temperatures up to 300 deg. F. and of platinum for higher temperatures to 1,800 deg. F. Three wires lead from the bulb to the instrument, eliminating any effect on the indications of the instrument due to changes in temperature along the wiring connecting the bulb to the instrument. The length of wiring is immaterial in the Brown three wire system and bulbs can be placed up to 1,000 ft. distant from the instrument using No. 14 gage copper wire or up to 2,500 ft. distant (half a mile) with No. 10 gage copper wire.

A recent development has been the perfection of a direct-reading resistance thermometer. For years resistance thermometers have been built on what is known as the zero or null basis. In this type of instrument a galvanometer pointer must be brought to zero and a reading then taken on a scale mounted in front of a rheostat. While quite accurate this method has the disadvantages of not being direct reading and the operator must obtain a balance by adjusting the slide arm of the rheostat so that the galvanometer indicates zero before the temperature reading is secured.

The Brown direct-reading resistance thermometer has a scale graduated directly in temperature degrees as illustrated. To check the instrument for zero reading, the left hand knob is turned to Z and then to S to check the instrument with a standard resistance at the top graduation on the scale, and in the third position the instrument is operated directly

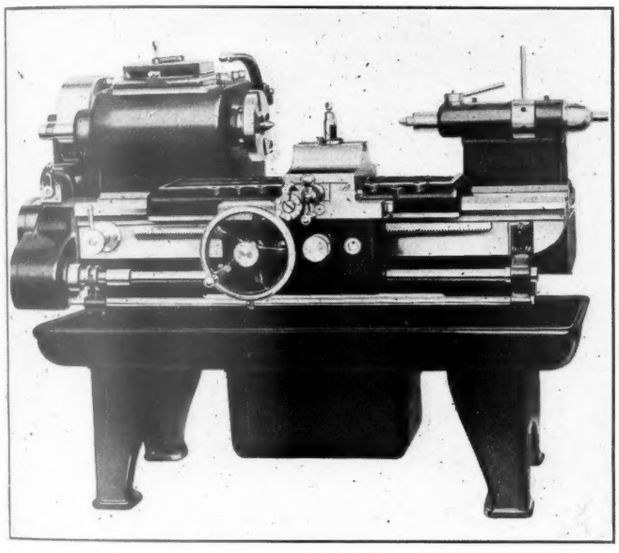
off the temperature bulb. The rheostat is the right hand knob on the instrument for adjusting the voltage. This check of the instrument while recommended daily need only be made every few days even where dry cells are used to operate the instrument since the current required is infinitesimal, and dry cells last four months without replacement. Where storage batteries are used a less frequent check is satisfactory.

By means of a switch the instrument can be connected to any number of resistance thermometer bulbs installed in different locations. Where used in dry kilns the instrument can be used to measure both temperature and humidity.

Applications where the Brown direct reading resistance thermometer can be used to advantage are in power plants for many temperature measurements, for the temperature of coal piles and numerous other applications.

Sundstrand Twelve-Inch Manufacturing Lathe

IN the 12-in. Sundstrand manufacturing lathe, developed by the Rockford Tool Company, Rockford, Ill., especial attention has been given to securing a compact, rigid machine, capable of standing up to the demands of specialized production and yet suited to a variety of work owing to the incorporation of the cross-feed, quick change feed, carriage reverse and a lead screw for thread cutting.



Front View of Sundstrand 12-in. Manufacturing Lathe

An idea of the compactness and rigidity of the machine may be obtained from the illustration. Separate ways are provided for the tool carriage, head and tail stock so that the carriage can travel to the end of the bed in front of the tail stock. This is an uncommon arrangement, eliminating overhang of the tail stock spindle on short length work and assuring great rigidity under heavy cuts.

The head stock is provided with single pulley drive equipped with a powerful friction clutch to the driving pulley. An outer bearing support relieves the belt strain on the driving pulley. It will be noted that the carriage has lugs on top, drilled and tapped to permit the mounting of extra cross slides, special tool holder blocks, etc. A special feature is the multiple stop collar which makes a positive stop for the cross slide when turning shafts with shoulders.

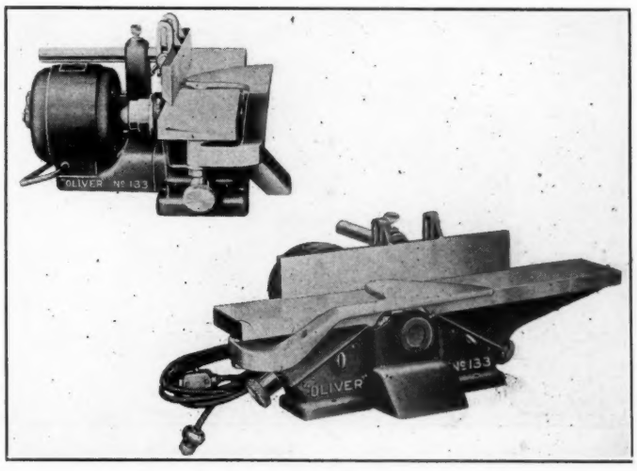
The apron is of the improved double wall type with a minimum of working parts and gears. A quick acting tail stock is regularly supplied and is a time saver in turning duplicate parts for the reason that it facilitates the work of operating the center. The lever is conveniently located and a slight turn will move the spindle to or from the work quickly. The rear tool is placed on the rear ways of the bed between the head and tail stock and can be located in different positions best suited for the work. It works simultaneously with the carriage and is driven by means of a rack fastened to the rear of the carriage.

The swing over the carriage of this lathe is 12 in. and over the cross slide 10 in., the distance between centers being 18 in. The diameter of the driving pulley is 12 in., a driving belt 4 in. wide being used. Twenty-nine feeds are provided ranging from .005 to .043 in. per rev. of the spindle. Nine spindle speeds are provided ranging from 36 to 251 r. p. m. In case of motor drive a 3-h. p. motor running at 1200 r. p. m. is recommended.

Portable Hand Planer and Jointer

TWO views of the portable hand planer and jointer recently placed on the market by the Oliver Machinery Company, Grand Rapids, Mich., are shown in the illustration. This machine has been designed to meet the demand for a portable, compact, motor-driven hand planer and jointer to replace the hand plane for jointing and fitting almost all classes of small work in wood construction. The machine is said to be thoroughly accurate and efficient, being fitted with ball bearings and arranged to run from any electric light socket or power circuit. The arrangement for safe-guarding are plainly shown in the illustration. The machine has a capacity to plane work 6¼ in. wide on the 6 in. machine and 4¼ in. wide on the 4 in. machine. Both sizes rabbet up to ½ in.

The tables are mounted on inclined dove-tailed ways, being raised and lowered by means of a hand-wheel and screw and being easily locked firmly in any position. Each table has a steel lip next to the throat opening. The fence can be quickly adjusted anywhere across the tables, also tilted and locked to any position up to 45 deg. It is 16 in. long, 2½ in. high and when not in use may be shoved back out of the way of the knife jointing and setting attachment.



Oliver Portable Hand Planer and Jointer

The cutter head is the three knife, circular, safety type, fitted with three tungsten-chromium thin steel knives which

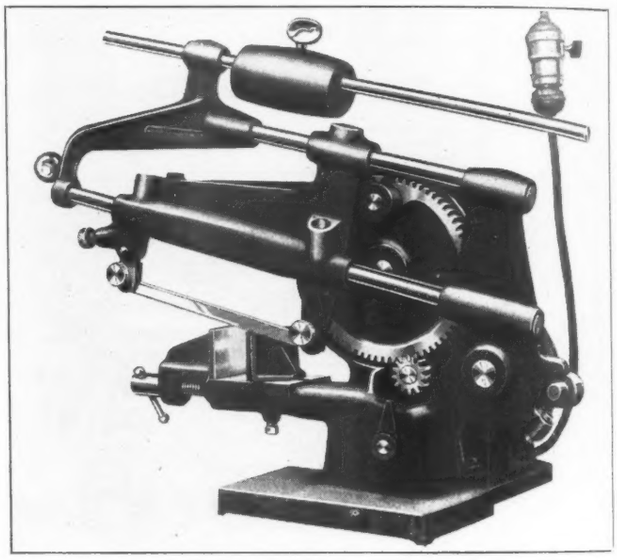
are ⅜ in. thick and 1 in. wide. The cutting diameter is 3½ in.

The motor is direct-connected by means of a universal flexible coupling. It is fully enclosed, well ventilated, and fitted with ball bearings, being designed to run at 3600 r. p. m. A ¼-hp. motor for the 4-in. machine and a ⅓-hp. motor for the 6-in. machine are required. The knife setting attachment is furnished when desired. It consists of a right angle way with a slide block, jointing stone and aluminum guard. It serves as a guide for setting the knives and by sliding the jointing stone back and forth while the cutter head revolves it will sharpen and join the knives so that all three knives will cut equally and produce much better work.

Motor-Driven Portable Bench Hack Saw

IT is a serious question whether the modern railroad shop man has as much patience and steadiness in using a hack saw or file as was common in former years. Fortunately, however, this is the age of machinery and comparatively few hand operations are now required. For example, the small motor-driven bench hack saw illustrated can be set up wherever convenient on the bench adjacent to an electric light cord and it will saw off any piece of iron within its capacity far more quickly, smoothly and with less damage to the saw blade than could be done by hand. Time is saved; physical effort is saved; saw blades last longer; and workmen can do something else while the machine is working. Another advantage is that this small hack saw can handle a large share of the work usually done on much heavier machines. It is designed for long life and ease of operation and all parts subject to wear are easily replaced. Both tool and machine steel can be cut efficiently and the machine is well adapted for use in toolrooms and machine shops, particularly those having considerable hack saw work formerly done by hand.

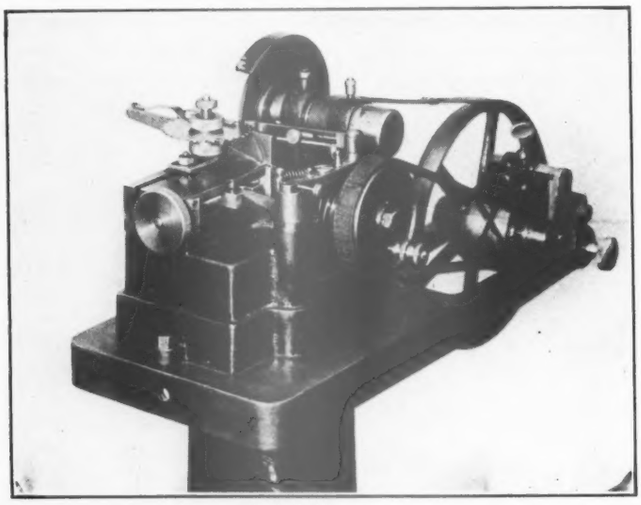
Power is supplied by a small motor direct-connected, the power being transmitted through cut gears. The machine is portable and can be attached to any electric light socket. It will be observed that cutting is done on the backward stroke, the saw blade being automatically relieved on the forward stroke which diminishes the wear and greatly prolongs the life of the blade. This portable bench hack saw is made by the Edlund Machinery Company, Inc., Cortland, N. Y.



Edlund Portable Power Hack Saw

Entirely Automatic Saw-Sharpening Machine

THE latest addition to the line of automatic saw-sharpening machines, made by George Scherr, New York, is the No. 2 machine illustrated. This saw sharpener is similar in construction to earlier models except that it has an increased capacity to sharpen and recondition saws, screw slotting cutters, fitting saws, etc., up to 8 in. in diameter. The machine is entirely self-contained being mounted on a cast-iron column. Its principal advantage is that the indexing is done by means of the saw to be sharpened so that differences in the thickness from tooth to tooth present no difficulty. The machine will feed without any trouble saws with one or more teeth broken out. The proper adjustment for feeding saws with teeth broken out is provided. The machine is easily operated and adjustments for different kinds and sizes of saws can be made easily and quickly, thereby saving time and enabling a large number of saws to be kept in condition by one machine.

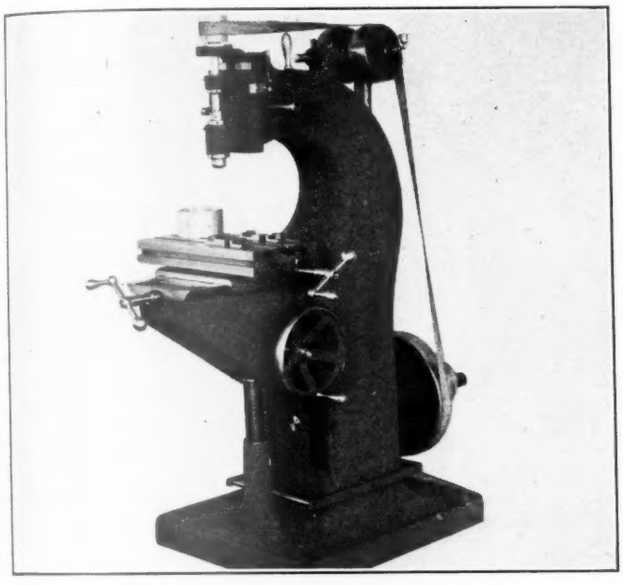


Scherr Automatic Saw-Sharpening Machine

This saw sharpener is a precision machine without unduly complicated parts and arranged so that the setting and resetting for work of one size or kind to the other requires but a few minutes time. It is especially valuable owing to the fact that it enables small saws under 6 in. in diameter and previously sharpened by hand tooth for tooth to be sharpened automatically. Not only is a tiresome hand operation now performed by the machine but the quality of the work is considerably better. More uniform cutting edges are secured resulting in better work. The specifications for the new No. 2 automatic saw sharpeners are as follows: It will sharpen saws from 1½ in. to 8 in. in diameter with thicknesses up to 5/32 in. The holes in the saws may vary from ⅜ to 1 in. The distances from tooth to tooth may be accommodated up to ⅜ in. Grinding wheels 4½ in. by ⅜ in. by ½ in. are used, 650 r.p.m. being recommended. The saw sharpener is mounted on a column 30 in. high. The net weight of the machine is 134 lb.

Vertical Miller Designed for High Speed

THE Becker Milling Machine Company, Worcester, Mass., has recently made changes in its No. 2 vertical miller which permit at least 50 per cent higher speeds than were formerly obtainable. This machine is now equipped with a ball auxiliary bearing to take the belt pull and hardened steel thrust washers are provided on the spindle. The main spindle bearing is bronze with a babbitt lining which has been found well adapted for high speeds. The spindle is made of crucible machine steel ground all over and carefully balanced. The pulley and all rotating collars and nuts are also balanced, and every effort has been made in the design to minimize vibration.



Becker No. 2 High Speed Vertical Miller

Two sizes of spindle pulleys are now furnished. On the No. 2 machine in addition to the usual 5-in. pulley, a 3-in. pulley is supplied for securing higher speeds. The operation of changing pulleys is simple, it being only necessary to lift one pulley by hand from the sleeve on which it rests and substitute the other. The belt slack is then taken up by means of the idler pulley bracket, which is adjustable.

It is now entirely practical to run the No. 2 machine at 6,000 r.p.m. and factory tests are said to have been run at considerably higher speeds, the proper attention being paid to oiling when running at these speeds. With a maximum speed of 6,000 r.p.m., two other speeds of 3,240 and 1,800 are obtainable using the 3-in. pulley, and by using the 5-in. pulley the following speeds are obtained: 3,540, 1,920 and 1,060. The necessary counter shaft speed is 540 r.p.m.

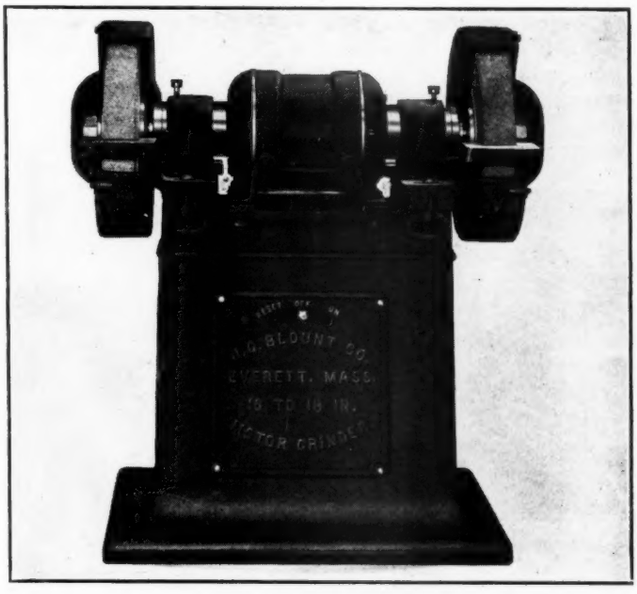
Other recent improvements in the No. 2 Becker miller are the new full box form knee, which is more rigid, and a steel chip guard in the knee in front of the carriage to protect the cross feed screw. A special canvas belt is furnished in the regular equipment which is particularly suited to high speeds. In case slower speeds with larger cutters are desired, it may be found advisable to change to a leather belt.

Heavy Duty Alternating Current Motor Grinder

MOTOR grinders of the heavy duty type and designed for operation on alternating current circuits have been developed by the J. G. Blount Company, Everett, Mass. Three-inch wheels, either 16 or 18 in. in diameter, are provided with this type of machine. The end shields are of cast-iron, turned and bolted directly to the motor frame. They are further secured in position by additional supports clamping around the end shield hub and then bolted to either side of the head casting. The end shield flanges are turned and threaded and screw into the ends of the shields.

Bearings for this grinder are of the S. K. F. double roll, heavy series type, being secured to the spindle by lock nuts. It is recommended that a high grade grease be used on the bearings. The spindles are turned from 45 carbon open hearth steel, being carefully ground and threaded. The rests are cast in one piece, being unusually rigid and adjustable to wear of the wheels. The flanges are machined all over and recessed on the inside, being heavy and conforming to the safety standards. Wheel guards are furnished of either the plain or exhaust types. Guards for 16-in. wheels may be supplied if desired. The starting switch furnished is a safety switch, mounted within the column on a separate panel and easily removable from the rear of the machine without disconnecting the switch. The switch is designed to protect both man and equipment against unexpected restarting and accidental starting of the motor. A 5-hp. motor designed to operate on 220 or 440 volts, two or three phase current, or 550 volts, 60 cycles, three phase can be provided.

It is highly essential that advantage be taken of every opportunity to secure an adequate number of modern grinders for railway shops and engine houses. The machines must be powerful enough to do miscellaneous grinding rapidly; they must be dependable and kept in good working condition; they should be provided in sufficient number to reduce unnecessary steps taken by shop men whenever they have a little grinding job to do.



Blount Heavy Duty Grinder Driven by A. C. Motor

Pinch Bug Riveter With Wide Range

UNUSUALLY wide range is one of the features of the new Shepard pinch bug riveter recently developed by the Hanna Engineering Works, Chicago. This riveter has a reach of 20 in. and the gap is 11½ in. or 18 in. depending on whether the short (channel jaw) or long (girder jaw) is used. The capacity of the riveter is 50 tons on the dies at 100 lb. air pressure and its weight is 1490 lb. which is relatively low in proportion to its capacity.

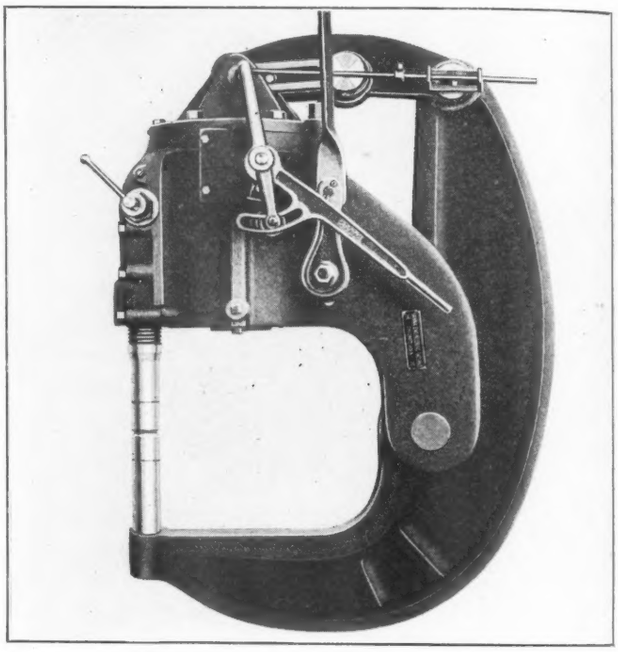
The angular movement is small due to the small radius from the hinge pin to the die axis. This allows greater variation in the length of the lower die. The die stroke of the Shapard riveter is 3⅝ in. The machine is equipped with a removable valve plate and an extra plate and valve allow maintenance of the valve without shut down.

In the Shepard pinch bug riveter, the upper die does not move as the rivet is driven when the machine is suspended with the die vertical. Rivets are placed from the top and driven from below and may be inserted far in advance of the machine itself. It is thus possible for the "rivet sticker" to devote some of his time to drift pins and stitching bolts without interrupting the continuous operation of the machine.

The suspension pin about which the machine is free to revolve is so located with relation to the center of gravity of the machine that the riveter when suspended naturally assumes a position resulting in the upper die screw being exactly vertical. The upper die screw remains vertical whether the unit is open or closed as the center of gravity shifts but lightly during movements.

The proper working suspension is easily obtained by merely hoisting the machine to the point where the upper die just rests on the work.

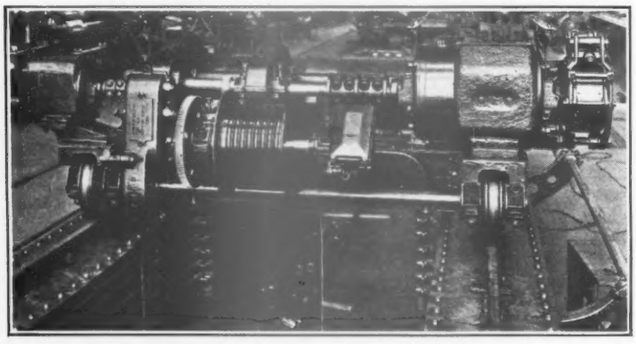
The Shepard pinch bug riveter is particularly adapted to light and medium weight structural riveting such as roof trusses, plate girders, beam box girders, crane girders, plate and channel columns, small plate and angle columns, lighter channel columns, steel car stills, etc. The unusual reach of the machine makes it an exceptionally flexible unit.



Shepard Pinch Bug Riveting Machine

Special Retriever Keeps Cable Always Taut

THE feeder cable retriever illustrated has been developed by the Pawling & Harnischfeger Company, Milwaukee, Wis., on the principle of keeping the crane cable taut at all times with a fixed but moderate tension constantly maintained, thus causing the cable to wind up and pay out without slack or undue strains. The retriever is designed to provide the fool proof construction needed in this type of equipment, more or less subject to abuse, and constantly exposed to the elements in all kinds of weather. It is of liberal proportions, the drum being provided with large flanges on both sides, and all bearings being bronze bushed.



Pawling & Harnischfeger Feeder Cable Retriever

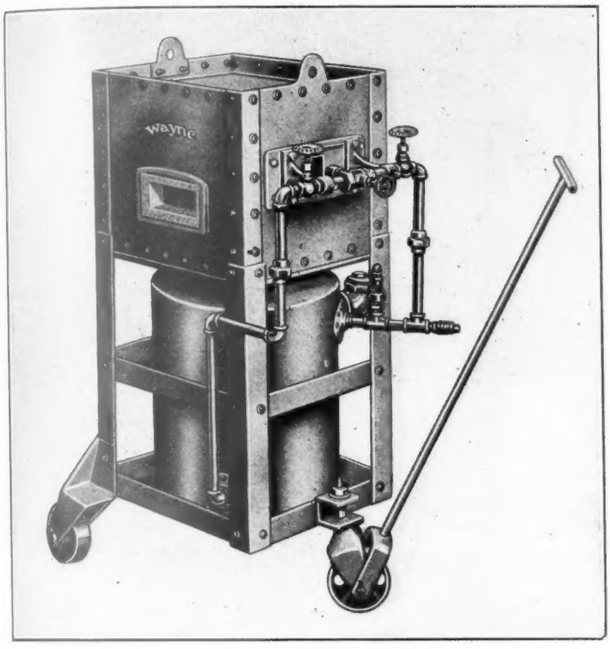
The magnet cable leads attached to the collector rings are passed through a hole in the center axis of the shaft to a point even with the arms of the cable drum. The cable here passes through an opening in the shaft along the drum arm to which it is securely attached. After passing the cable through the hole in the rim it is coiled in the outside of the drum, thus making a secure attachment and leaving no exposed electrical contacts.

The improved cable drum is driven only in the hoisting direction. The drive consists of gearing from one of the shafts of the hoisting mechanism, the final drive to the cable drum being by friction. The gearing is so proportioned as to tend to drive the drum at a peripheral speed greater than the magnet being hoisted. This arrangement causes the friction drive to slip, producing a moderate tension in the magnet cable. Should there be several feet of slack in the cable when the magnet is hooked on the crane this slack will be taken up in the first hoisting operation.

The cable drum is not driven in the lowering direction. A pawl engages in a ratchet wheel attached to the driving friction, preventing it from revolving. The cable drum is then unwound, due to the pull of the cable while the magnet is lowered. A raveling or too rapid unwinding of the cable is prevented, however, by the resistance of the stationary friction against the cable drum which produces the same tension or pull on the cable in the lowering as in the hoisting direction.

Portable Forging and Rivet-Heating Furnace

THE portable oil-burning forging and welding furnace shown in the illustration has recently been developed by the Wayne Oil Tank & Pump Company, Ft. Wayne, Ind. It is especially adapted for shops where the forging or rivet-heating equipment must be readily moved about in order that the work may be more speedily and easily accomplished. The furnace is substantially but lightly made.



Wayne Portable Oil-Burning Furnace

The furnace is approximately 51 in. high overall, 25 in. from the front to the back, and 31 in. wide. The handle is 40 in. long and attached to the guiding castor. The furnace body is made of 14 gage black iron, held by heavy angles, and is 16 in. high, 18 in. wide and 16½ in. from the front to the back. The work opening is 6 in. wide, 3 in. high at the edges and 4 in. high in the center. The working space is 9 in. wide and 7 in. deep, exclusive of the tile opening, which is 5¾ in. from front to back.

The supporting frame which surrounds the tank is made of heavy angles. The tank itself, which is flame welded, is constructed of black iron with a 3/16-in. shell and ¼-in. heads. The tank is designed to withstand a working pressure of 100 lb. per sq. in. It is 17 in. in diameter and 22 in. long and has a capacity for 14 gal. of fuel, sufficient for 10 hours of normal operation. The tank is fitted with a safety valve. The 2-in. air-tight filling opening is conveniently located.

This machine is particularly valuable for rivet heating work in railway shops, especially the boiler shop, tank shop and steel car shop. In these places its flexibility and ready movement from place to place are important advantages.

As shown in the illustration, the Wayne portable forging and rivet heating furnace is supported on three substantial castors of large diameter. The two in the rear run on bearings in brackets firmly riveted to the main furnace and frame work. The third guiding castor, as it is called, is arranged to swivel, being guided by the long handle previously referred to. By means of this handle one man can readily move the furnace to the most convenient location with respect to the work. Two ears are provided on the upper part of the furnace for the insertion of small hooks and a chain or some other arrangement, enabling the furnace to be lifted by a crane from one department to another. A safety valve protects the tank from excess pressure.

Power-Driven Tube-Shearing Machine

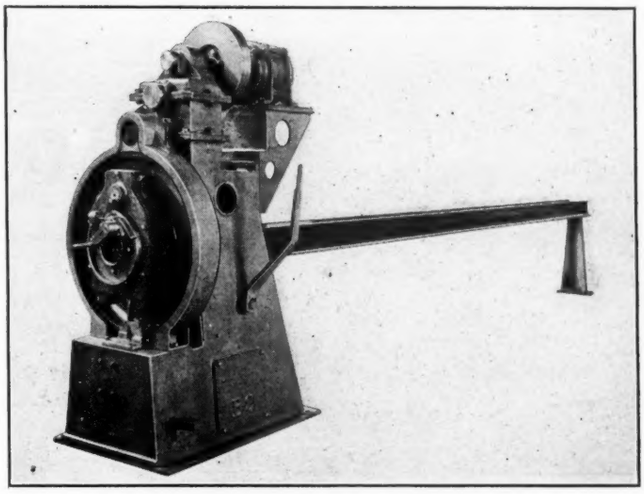
WITH the object of providing a machine for shearing pipes and tubes rapidly, without loss of material, with a square cut free of fins and without revolving the pipe or tube, the Laughlin-Barney Machinery Company, Pittsburgh, Pa., has developed the tube shearing machine illustrated.

In general design this machine is compact, rugged and simple thus meeting the fundamental requirements of machine tools used in railroad shops. All gears are fully covered for the protection of the operator. The shearing principle employed is quite novel and consists of an internal arbor and two shear knives in the form of two hardened steel rings which are placed close together, and through which the pipe or tube passes (these shear knives do not revolve). One knife is held concentric and the other carried in the shear head which follows an eccentric path, thus causing the pipe or tube to be sheared off in one revolution of the machine.

This method of shearing is said to have little wearing effect on the cutting edges of the knives and owing to their simple design they can be quickly removed and easily sharpened by grinding the sides of the knives.

The machine is under entire control by the operator at all times, this being accomplished through a positive clutch operated by a foot treadle which permits either intermittent or continuous operation as desired. These machines can be furnished either belt or motor driven and for shearing practically any size or kind of tubing.

The tube shearing machine, illustrated, is motor driven by a motor mounted on a bracket attached to the upper machine frame work. The two shear knives are driven through reduction gearing, all of which is carefully guarded. The machine is operated by means of the levers, conveniently placed. A support for long tubing is provided as shown at the right.



Laughlin-Barney Tube-Shearing Machine

Rotary Pump Has Five Movable Parts

THE Curtis rotary pump, manufactured by the Pittsburgh Machine Tool Company, Braddock, Pa., has been improved lately and developed to a point where it can handle water up to 400-ft. heads. The entire construction has been changed so as to make a pump suitable for unusually severe service. These pumps are made in capacities from 15 up to 300-gal. per min., having only five moving parts and buckets or impellors which are made of bakelite, being about 40 per cent the strength of cast-iron and nearly frictionless. The buckets as shown in Fig. 1 are held out against the liner by pressure in the pump itself. The bearings are of lignum vitæ which is the same material as used on stern bearings in steamships where it is impossible to oil, and if through negligence these bearings do not get lubricated they work very well with water as a lubricant.

The new pump is said to have a high efficiency and low maintenance cost. The water in the pump is carried around through the part shown in the end plate and underneath the buckets which holds them out against the liner. The pumps are designed to be self-priming and develop a vacuum of 27 in. They are compact and light in weight. They are strictly rotary pumps as distinguished from centrifugal or gear pumps. The solid rotor revolves in the eccentric body with blades or buckets which create suction and discharge.

When installing a Curtis rotary pump, it is advisable to get the pump as close to the supply as possible. Long suction lines are undesirable as they are liable to be leaky and also it takes some time to exhaust the air before the pump will prime. In places where long suction lines cannot be avoided, it is sometimes advisable to put a standpipe on the discharge line with a valve close to the discharge line. This standpipe can be filled when the pump is discharging and used as a primer when restarting the pump.

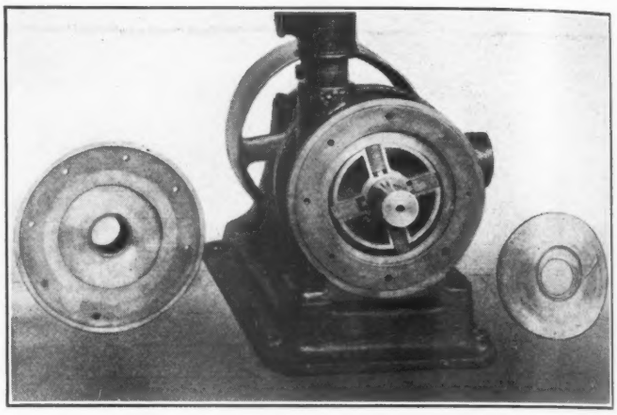


Fig. 1—Interior View of Curtis Rotary Pump

Power Drive for Hand Threading Parts

ANYONE who has ever tried to cut a 2-in. pipe thread by hand can testify to the amount of physical effort involved and will probably be an ardent advocate of any effective method of doing the work by power. The machine illustrated has been developed recently by the Toledo Pipe Threading Machine Company, Toledo, Ohio, for this purpose, namely to provide power drive for the hand pipe-threading devices which are made by that company.

Toledo Power Driving Unit and Head Cutting 4-in. Pipe Thread

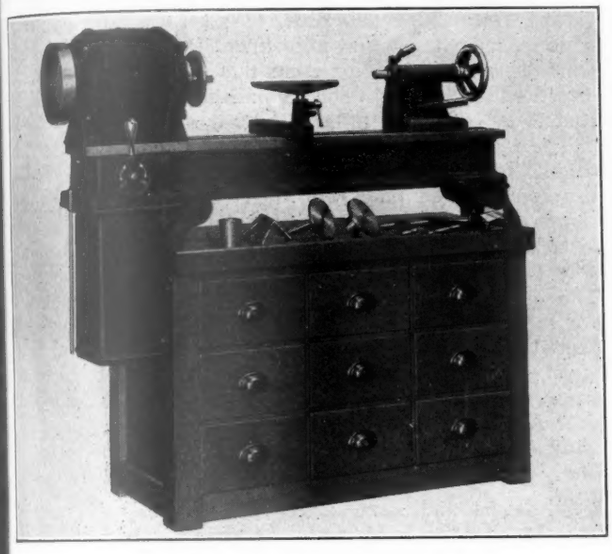
Tests indicate that this device has great time- and labor-saving possibilities, it being possible to cut a 2-in. thread in 18 seconds, a 4-in. thread in 2 min., a 6-in. thread in 3 min. or a 12 in. thread (including the time necessary to run over the pipe with a set of blank dies to true up the surface) in less than 15 min. These are said to be actual working figures which can be reproduced regularly on any pipe-threading job.

The device consists of an especially designed electric motor mounted in a housing that also encloses transmission gearing, communicating to a driving shaft, extending to the operating end of the shaft housing, the whole mechanism being mounted on wheels thus providing for easy movement from place to place. Mounted on the shaft housing just above the motor is a fuse box containing two especially designed fuse plugs which will permit of normal loads but blow should any overload become dangerous to the life of the motor. Mounted midway on the shaft housing is a switch box to which the flexible cable is connected by a two pole plug.

The driving head is furnished with two bushings, one containing a cored hole 15/16 in. square and the other containing a cored hole 1 1/16 in. square, these holes being supplied to fit the two sizes of pinions used on the various Toledo tools. At slow speed the driving head rotates at 38 r.p.m. and on high speeds at 57 r.p.m. While designed primarily for the operation of pipe cutting and threading tools, this machine has also been utilized for the operation of a hand winch and in another case for operating bending rolls in a sheet metal shop. This type of tool is to be recommended for shops having an occasional heavy thread cutting job which does not occur frequently enough to warrant the installation of a large power threading machine.

Alternating Current Motor Headstock Speed Lathe

THE latest lathe development of the J. G. Blount Company, Everett, Mass., is a 12-in. alternating current motor-headstock speed lathe designed to meet the requirements of any pattern shop. This machine, which is



Blount Direct Motor-Driven Speed Lathe

provided with S. K. F. ball bearings, can be mounted on a bench as shown in the illustration. The headblock, consisting of a rotor and outside frame together with necessary windings, is supplied by the Westinghouse Electric & Manufacturing Company. The motor frame is a cylindrical iron casting with openings at the bottom to bring out the leads to the controller, which is directly beneath and totally enclosed. The end brackets are solid, thus making a fully enclosed motor. The feet are cast integral with the brackets, giving strength and rigidity to the motor. The bearings are mounted in dust-proof housings and secured to the spindle by suitable lock-nuts. The bearings are of larger size than regularly furnished on these headblocks, and take end thrust in either direction.

The spindle is made of 45 carbon steel, carefully turned, threaded and ground, with a ⅝ in. hole bored the entire length. The nose end of the spindle is 1⅛ in. outside diameter, threaded on the end with 10 V threads per inch to receive a face-plate, chucks, or other equipment.

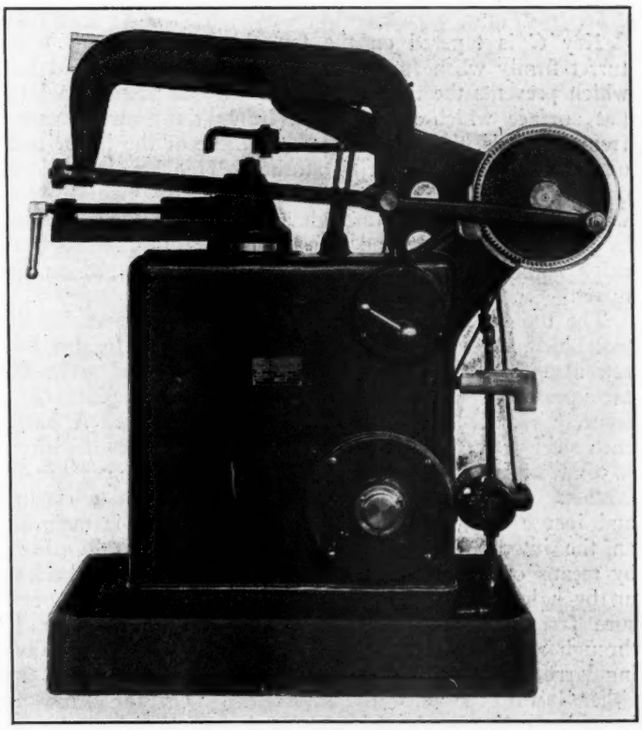
A Morse No. 2 large taper is used for the live center, and by using this particular size of taper, a much larger hole can be bored in the spindle than otherwise. The rear end of the spindle has the same size of thread as the nose end. An outside face-plate and pulley combined, 8 in. in diameter, completes this unit.

The distance between centers is 25, 37 and 49 in. on the 4-ft., 5-ft. and 6-ft. beds respectively. The portion of the bed under the headstock is widened out to allow for the controller thus fully enclosing it. A hand wheel gives four spindle speeds of 575, 1160, 1750 and 3450 r.p.m. respectively. Each lathe is provided with one spur and cup center, three T-rests, a 5½-in. faceplate, a 3-in. screw chuck and a 2½-in. by 4-in. right angled rest.

Self-Contained Motor-Driven Hack Saw

THE electrically driven hack saw outfit shown in the illustration is unique in that the motor is housed in the base, thus making a compact self-contained unit which can be mounted on wheels if desired and used as a portable machine. This motor and its control switches are built into the machine in such a manner as to be out of the way and at the same time protected from injury. The ½-hp. ball bearing motor used with the equipment may be had for any commercial voltage desired. The length of the saw used is 16 in. and the length of the stroke is adjustable between 5 and 7 in. The saw can be operated at either 45 or 90 strokes per minute so that hard or free cutting stock can be cut with best results. The saw can be raised and held in any position. The feed is by gravity and an automatic stop is arranged to stop the motor when the work is cut off. The saw slide is above the blade where cuttings and grit will not fall on the sliding surfaces. An oil pump may be used if desired. The vise swivels are graduated for cutting angles.

There are many places in railroad repair shops where power hack saws are used, including the machine shop, tool-room, blacksmith shop and even in the stores department where bar stock must be cut to required lengths on orders from the various shop departments. It is essential that the tool be of ample power, easily operated and require little attention aside from the setting up and removal of the work. The fact that the new machine illustrated is driven by a self-contained electric motor makes it a flexible unit and one which can always be located in the position most convenient for the work and irrespective of the location of line shafts and driving pulleys as would be the case with belt-driven machines. Compactness is also an important feature of this machine which has a height of 36 in., occupies a floor space of 18 in. by 39 in., and weighs 450 lb. This hack saw outfit is being marketed by the Louisville Electric Manufacturing Company, Louisville, Ky.



Portable Self-Contained Power Hack Saw

Turret Tool Post for Wheel Lathes

FOR the benefit of those who prefer a turret to a pneumatic tool post the Niles-Bement-Pond Company, N. Y., has developed a rugged, two-position tool post, revolving in a vertical plane, as shown in Figs, 1 and 2, for use on car and driving wheel lathes. Features of special merit are the location of the roughing tool in the solid part of the tool post and the provision of a wide taper key, making the turret practically solid after adjustment. The turret *A* is a massive piece of forged, oil-hardened die steel ground and polished, designed to withstand shock and dissipate the heat from the cutting tools without distortion or annealing. Spindle *B* is of a large diameter, made from high-carbon steel. The turret is pressed on and bolted to the spindle which makes it equivalent to one solid unit.

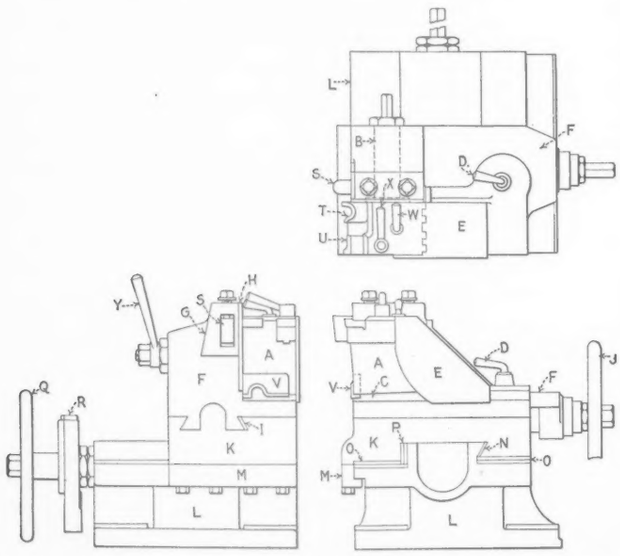


Fig. 1—Details of Turret Tool Post, Revolving in Vertical Plane, Designed for Use on Niles-Bement-Pond Wheel Lathes

Key *C* is tapered on the top side only and holds the turret firmly when forced underneath, forming a rigid lock which prevents the turret from turning. It presents a large flat surface which sustains the heavy downward pressure from the tools, thus relieving the spindle of the turret from undue torsional or shearing strains. This key is made of oil-hardened die steel ground to insure easy manipulation, which is accomplished through a rack and pinion actuated by lever *D*. The key and turret are carefully guarded from chips and dust by chip guard *E* which is hinged on the turret.

The top cross slide *F* is a right angled support for the tool block, the vertical part forming a bearing for the turret, also carrying the round nose roughing tool. On the face presented to the wheel a hardened steel plate *G* is securely fastened to prevent cutting from chips. A hardened steel plate *H* is bolted to the face adjacent to the turret so that when indexing two hardened steel surfaces are in contact. This is done to prevent wear, eliminate cutting and insure easy manipulation. The top slide is mounted on the intermediate slide by an inverted dovetail gibbed by means of a tapered packing *I* which in turn is backed up by a large section of metal to withstand the side pressure from the roughing tool. The cross adjustment is through an 18-in. hand wheel *J*, mounted on a screw having large double ball thrust bearings taking the thrust for either inward or outward adjustment. On the screw is located a collar graduated to 1/64 in. so that the operator can feed in the tool to any desired amount.

Intermediate slide *K* is made of semi-steel mounted on carriage base *L* by a combination of square locks *M* and tapered surface *N*. The components of force from the cutting tool (downward and backward) are taken on hardened steel plate *O* and *P*. These plates are to prevent cutting from chips and dust, also for easy manipulation. This member has lateral adjustment by means of an 18-in. hand wheel. The thrust from this screw is taken in both directions on a large double ball thrust bearing. Power feed to this screw is through ratchet *R*.

The round nose roughing tool *S* is 1½ in. wide by 3 in. deep. It is subject to the heaviest cutting load and is, therefore, carried on a hardened serrated steel plate, and clamped by two large hardened steel screws. The other tools are carried on two faces of the turret, thus requiring only two indexings for the complete turning of the wheel. The flange roughing tool *T* and tread chamfering tool *U* are carried on one face and the flange finishing tool *V* is carried on the other face. Tools *T* and *V* are bolted to the turret, whereas tool *U* is carried on a slide, brought into action through a cam actuated by lever *W* and clamped by lever *K*.

Operation of Turret Tool Post

All levers and hand wheels are within easy reach so that the operator can stand between the rests and see the cutting tool in operation and from this position manipulate

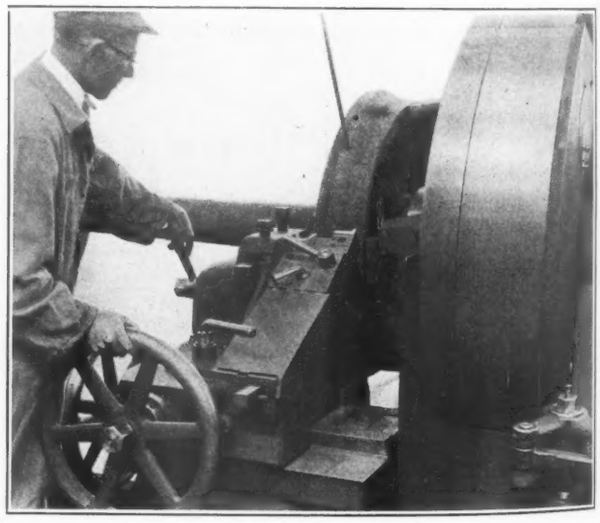


Fig. 2—Turret Tool Post Just Being Turned to Bring the Finishing Tools Into Play

the turrets. With the turret in the position shown in Fig. 1, the tread and top of the flange is turned off by tool *F*, by means of power feed. With a slight additional movement in the same direction through hand wheel *Q* tool *T* is brought into action. Without any lateral movement the turret is indexed, bringing into action tool *V*.

The indexing is done by withdrawing key *C* by lever *D* and revolving the turret through 90 deg. by lever *Y*. The turret is locked by bringing the key forward. It only requires four turns of the hand wheel *G* to withdraw the top slide sufficiently for indexing the turret. The indexing time is a fraction of a minute. The turret is again indexed back, bringing tool *U* into action. This completes the cycle of operation and leaves the turret in position to begin the next wheel. A complete set of tools is regularly furnished with each turret.

GENERAL NEWS

Weights for Car Billing Purposes

The Arbitration Committee of the Mechanical Division of the American Railway Association has issued an approved table of weights to be used in preparing and checking bills for freight car repairs. This includes the weights of bolts, including one nut; the weights of nuts; wrought iron washers; journal bearing wedges; coupler yoke rivets; flat rolled iron bars, and round iron bars.

Unit Cost of Train Operation

The average cost per freight train mile, for the selected accounts which the Interstate Commerce Commission uses to indicate unit costs of train service, for the year 1921 was $1,799, according to the commission's monthly bulletin for December and 12 months, as compared with $2,054 in 1920, a reduction of 12 per cent. Reductions were shown for each of the accounts used. The cost of coal per net ton, including freight, was $4.10 as compared with $4.20 in 1920, a reduction of 11 per cent, and the cost per passenger train mile was $.993 as compared with $1.098, a reduction of about 10 per cent. The selected accounts are locomotive repairs, engine house expenses, enginemen, trainmen, fuel and other locomotive and train supplies.

Freight Car Surplus

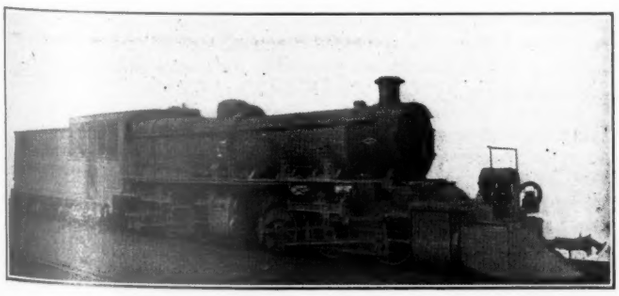
According to the reports of the Car Service Division of the American Railway Association, the freight car surplus during the week ending April 15 showed a large increase, due to the lack of demand for coal cars, to 333,393, of which 98,686 were box cars and 187,918 were coal cars.

The decrease in coal production also accounts for a further increase in the freight car surplus during the period from April 15 to 23 from about 333,000 to 371,764, of which 229,892 were coal cars and 98,406 were box cars.

The number of surplus freight cars during the week ending April 30 showed a decrease of 126 to 371,538. This included 235,077 surplus coal cars, an increase of 5,185 within the week and 94,653 surplus box cars, a decrease of 3,753.

Meter Gage Mallets for Burma

The accompanying photograph depicts a locomotive recently built by the North British Locomotive Company, Ltd., Glasgow, Scotland, for the Burma Railways (meter gage). This locomotive is a Mallet articulated compound and develops 22,170 lb. tractive effort at 50 per cent of its working pressure, which is 180 lb. The wheels are 3 ft. 3 in. in diameter. High pressure cylinders are 15½ in. in diameter and low pressure cylinders 24¼ in. Saturated steam is used and is generated by a grate area of 33 sq. ft. The engine weighs 133,000 lb. and is equipped with a Pyle National electric headlight. These locomotives are the sixth lot of North British locomotives delivered to India and Burma. They were built in accordance with the instructions of Messrs. Rendel, Palmer and Tritton, consulting engineers for the Burma Railways. The photograph and the data presented here were taken from Modern Transport (London).



Mallet With Tractive Effort of 22,170 Pounds

Freight Car Loadings

In spite of a decrease in coal loading of 71,195 cars as compared with the corresponding week of last year, the total number of cars loaded with revenue freight in the week ending April 15 and reported by the Car Service Division of the American Railway Association was still somewhat greater than it was last year, 706,713 as compared with 702,116. It was also much greater than it was for the corresponding week of 1920, when, due to the switchmen's strike, the loading dropped to 601,695.

The number of cars loaded with revenue freight during the week ended April 22 showed increases both as compared with the previous week and with the corresponding week of last year, in spite of the light coal loading on account of the strike. The total was 714,088 as compared with 704,632 in 1921 and 717,772 in 1920.

A large increase was reported for the week ended April 29 both as compared with the week before and as compared with the corresponding week of the previous year, in spite of the light loading of coal. The total was 758,286 as compared with 721,084 in 1921 and 800,960 in 1920.

During the week ended May 6 a slight reduction was shown as compared with the week before, to 755,749 from 758,286. This represented an increase as compared with the corresponding week of last year, when the loading was 721,722, in spite of the continuance of the coal strike, but was far below the loading for the corresponding week of 1920, which was 843,184.

A. R. A. Recommends New Interchange Practice

The recommendation of the Joint Committee on Interchange of Equipment of the American Railway Association relative to joint interchange inspection of equipment, which was submitted to a letter ballot of the Association, has been approved by a vote of 303 to 14, with 81 not voting.

The recommendation, which follows, has been adopted by the A. R. A. as recommended practice.

It is the opinion of the Joint Committee that special rules of general application covering joint inspection of equipment in interchange cannot be formulated for the reason that local conditions must govern; that existing A. R. A. rules will enable interested roads to agree on inspection of equipment.

It is, therefore, suggested in the interest of economy in operation and to facilitate the movement of cars, that where inspection of equipment is involved at any point of interchange, that the interested roads arrange for conference to study conditions at that point. The following principles to govern any arrangements which may be adopted: 1.—Observance of A. R. A. rules. 2.—No backward movement of cars. 3.—No duplicate interchange inspection of cars. 4.—No delay to cars due to inspection in order to fix responsibility for damage to cars, adjustment or transfer of lading.

There are various forms of interchange inspection which can be adapted to these principles, some of which are outlined below:

A.—Joint Inspection—Where all of the inspectors are joint men under a chief joint inspector.

B.—Inspection Under the Jurisdiction of an Arbitrator—Where inspectors are in the employ of various railroads under the jurisdiction of an arbitrator, whose duty it is to harmonize and unify inspections and settle any disputes which may arise without holding cars or lading for this purpose.

C.—Delivering Line Inspection—Where interested roads accept the delivering line inspection.

D.—Receiving Line Inspection—Where interested roads accept the receiving line inspection and handle each other's defect cards.

E.—Inspection by Receiving Line's Inspectors in Delivering Line's Yard—Where receiving line inspectors make inspection in delivering line's yard.

F.—Joint Inspection and Repairs—Where a single organization in a joint terminal makes all inspections and repairs for the interested roads.

Special Train from Chicago for June Convention

For the convenience of persons going to Atlantic City to attend the convention of the Mechanical Division of the American Railway Association, which meets from June 14 to 21, inclusive, the Pennsylvania System will run a special train leaving Chicago at 1 p. m., central time, on June 12 and arriving at Atlantic City at 10:45 a. m., eastern time, on the following day. The train will consist of club, open section, drawing room and compartment cars, and a dining car.

The International Locomotive Association

The International Locomotive Association is now being promoted, having for its object the study of the history and development of the locomotive; and the preservation of records pertaining thereto. In carrying out these aims the co-operation of all interested will be welcomed.

Information in regard to the activities of the association will be made available to the members through the agency of a bulletin, in which articles of a suitable nature will also appear.

The Organization Committee consists of Arthur Curran, 16 Ballard street, Newton Center, Mass.; Charles B. Chaney, 97 Lafayette avenue, Brooklyn, N. Y., and Norman Thompson, 340 Spence street, Winnipeg, Manitoba.

Supplement to 1921 Rules of Interchange

A supplement to the 1921 Rules of Interchange has been prepared by the Arbitration Committee and the Committee on Prices for Labor and Materials of the Mechanical Division of the American Railway Association. This supplement includes several interpretations of the Rules of Interchange as rendered by the Arbitration Committee and the following modifications of the rules relative to prices for labor and materials:

Rule 101.—Entirely revised on account of present market prices and labor per hour revised to $1.10 per hour. Revision effective May 1, 1922.

Rule 107.—Several items revised on account of revision of labor rate, effective May 1, 1922.

Rule 112.—Reproduction cost per pound prices for settlement for cars destroyed reduced 30 per cent, effective May 1, 1922.

Passenger Car Rule 22.—Material allowances revised on account of present market conditions.

Wage Statistics for Last Half of 1921

The Interstate Commerce Commission has issued a consolidated statement of its wage statistics of American railroads for the six months July-December, 1921, during which its new classification of railroad employees was in effect, as well as the reduction of wages ordered by the Railroad Labor Board effective on July 1. The average number of persons in the employ of the railroads for this period shows a decrease of 416,384, or 19.7 per cent, as compared with the same period of 1920. Compensation decreased $690,829,775 or 33.9 per cent. The average number employed at the middle of the month was 1,692,794 and the average number of full-time positions was 1,592,755, while the total compensation for the six months was $1,343,886,463, of which $70,478,076 represented overtime and $55,487,464 "other compensation." In the next column a table is shown giving a recapitulation, to which has been added a column showing the average earnings per employee per month.

Carefulness Among P. R. R. Employees

The Pennsylvania Railroad reports a reduction of 55 per cent in fatalities and 37 per cent in injuries among employees during 1921 as compared with 1920. After making allowance for a decrease of 25 per cent in the average number of employees in the service during 1921, the net reduction in the accident frequency was 40 per cent in fatalities and 15 per cent in injuries.

Nine operating divisions and five shops, with a total of 19,000 employees, passed through the year without a fatal accident to an employee. The divisions are Cresson, Delaware, Norfolk, Schuylkill, Wheeling, Logansport, Richmond, Zanesville and Peoria, and the shops are Trenton, Hoboken, Altoona Car Shop, South Altoona Foundry, and Juniata. The reduction was primarily due to dull times, a light labor turnover, and few inexperienced men in the service, and to the effect of the safety movement. Many dangerous conditions have been removed, safeguards for machines installed, and working conditions generally improved.

Federal Trade Commission Investigates Proposed Steel Merger

Upon receipt of the resolution adopted by the Senate on May 12, introduced by Senator La Follette, directing the Federal Trade Commission and the attorney general to inform the Senate as soon as possible what steps have been taken or what steps will be taken to ascertain the purposes and probable effects of the proposed merger of seven of the largest iron and steel corporations, the Federal Trade Commission, on May 13, sent a demand in a telegram to the presidents of the Midvale Steel & Ordnance Company, Republic Iron & Steel Company, Lackawanna Steel Company, Inland Steel Company, Youngstown Sheet & Tube Company, Steel & Tube Company of America, Brier Hill Steel Company, and the Bethlehem Steel Corporation, asking them to submit to the Federal Trade Commission full and specific information as to the plan of the proposed merger before the plan is consummated or actual transfers made.

In this connection the commission states that the proposed merger was called formally to its attention on December 27, 1921, and that the matter has been under investigation since that time.

The Labor Board's New Quarters

The Railroad Labor Board is now located in the Transportation building, 608 South Dearborn street, Chicago, and all communications intended for the Board should be addressed accordingly. Unless otherwise advised, all hearings will be conducted in the new hearing room on the twenty-second floor of the above-mentioned building.

Labor Board Decisions

COMPOSITE MECHANICS AND SIGNAL MAINTAINERS.—A controversy arose on the Chicago & Alton with regard to the application of the minimum rate of composite mechanics to signal maintainers with less than four years' experience who were considered composite mechanics because of the ruling of the United States Railroad Administration. The carrier contended that the employees were men of less than four years' service prior to the date of issuance of Supplement No. 4, to General Order No. 27. The employees claimed that no distinction was made in this supplement between electrical workers and signal maintainers and in view of the fact that the men involved in this dispute received the minimum rate of their craft prior to the date of issuance of the supplement, they should have been paid the minimum rate for composite mechanics with four years' experience. The Labor Board decided that employees receiving an amount equal to or in excess of the minimum rate paid prior to the issuance of Supplement No. 4 should be paid the minimum rate of the highest rate of craft represented in such composite service and that such employees receiving a lower rate than that paid any of the craft of which they were the composites should receive the step rate in accordance with their experience.—*Decision No. 795.*

Two Years' Work of the Labor Board

During the first two years of its existence the United States Railroad Labor Board passed upon 632 questions, according to a report which it has just prepared. In the calendar year 1920 it issued 42 decisions, 14 interpretations and 6 addenda, while in 1921 it prepared 539 decisions, 17 interpretations and 14 addenda. During the latter year the board issued two major decisions applicable to rules governing the working conditions of employees, Nos. 222 and 501, the first covering shop craft employees and the latter maintenance of way workers. Since the first of the present year the board has rendered additional decisions governing the working conditions of clerical workers, signalmen, train dispatchers, express employees, trainmen and oilers, supervisors of mechanics and telegraphers.

Decision No. 2 of the board, which was issued on July 20, 1920, and was retroactive to May 1 of that year, covered 140 parent companies and their subsidiaries, and several terminal companies, the exact number not being known. Decision No. 33 (electric lines decision) affected 11 companies, while Decision No. 198 (short line decision) was applied to 67 companies, the three decisions

enumerated above totaling 235 companies in all. It is estimated by the board that the annual increase in payrolls due to Decision No. 2 amounted to $558,180,134.56, this figure covering straight time earnings for all employees except those engaged in train and engine service for whom all time was taken into consideration. The estimated annual decrease in the payrolls due to Decision No. 147 amounted to $378,004,675.80, this figure also covering straight time earnings for all employees with the exception of those in train and engine service as mentioned above.

The number of employees in the service of the companies has fluctuated widely. The compensation report compiled by the Interstate Commerce Commission for the month of December, 1921, shows that there were then 1,637,151 men in service, while the report for August, 1920, gives the number as 2,197,784, these figures indicating the minimum and maximum employment. The decisions rendered by the board during 1920 and 1921 involved 45 employees' organizations.

London & North Western Adopts Council System for Dealing With Labor Matters

The London & North Western has announced its plan for the establishment of councils of employees and officers to bring about closer contact with the management, according to Modern Transport (London). This is in accordance with the Railways Act of 1921.

The plan provides for the formation of a council composed of not more than four members representing the employees and an equal number representing the management at every shop or station where 75 or more persons are employed. At places where fewer men are employed, a council of four representing the employees will confer with local officers. The purpose of these councils is to provide a recognized method of communicating with the employees and to give them a wider interest in the conditions under which their work is performed. The matters to be considered by the local committees are:

(1) Suggestions for the satisfactory arrangement of working hours, etc.

(2) Questions of physical welfare (safety appliances, first aid, accommodations for comfort, etc.)

(3) Holiday arrangements.

(4) Publicity regarding rules.

(5) Suggestions as to improving efficiency.

(6) Investigation of conditions tending to reduce efficiency.

(7) Correct loading of freight.

Employee representatives are to be elected from among their number, each employee over 18 years of age being privileged to vote. Representatives must have been in service at least a year. Complaints by employees must be made directly to the company as heretofore and will then be referred to the council.

Matters relating to the local application of the national agreements as to wages, working conditions, etc.; suggestions as to improved operation; points in which employees and management are mutually interested, such as increasing business and promoting economy; and subjects submitted by the local council—all these matters will be handled by sectional councils (likewise representing both employees and management), of which there are five, each covering the entire railway. These councils may not propose any changes inconsistent with rulings of the Wages Board.

The employee representation, Sectional Council No. 1, will be made up of stationmasters, agents, yard masters and traffic controllers (2 representatives); clerks (7 representatives); operating and freight traffic inspectors and foremen and dock supervisory staff (2 representatives); and inspectors and foremen in the locomotive, car engineering, signal, telegraph and tugboat departments (1 representative). Sectional Council No. 2 will be made up of enginemen and motormen (12 representatives); No. 3 of signalmen, trainmen, porters, switchmen, car cleaners and car inspectors (12 representatives); No. 4 of freight house, delivery and dock forces (12 representatives); and No. 5 of maintenance of way and signal department employees and linemen (10 representatives).

The company will choose its representatives on each council from among its various officers. The plan provides for a railway council for the whole railway to deal with any matters which can properly come before a sectional council but which affect employees belonging to two or more sectional groups.

When agreements are arrived at by councils they are to be posted for the information of employees. Disagreements are referred to the trade unions, who confer with the railway managements, and if agreement is not reached, to the Central Board.

British Ordnance Works Built 100 Locomotives as Yet Unsold

British ordnance works built 100 locomotives following the armistice in order to prevent a complete shutdown and the sudden discharge of thousands of men, according to the Times (London). These locomotives are as yet unsold and until they can be disposed of represent an investment of some $2,500,000 of the government's money on which there is no return.

Railway Labor Disputes and the Federal Power

A discussion of the "use of federal power in railway labor disputes," by Clyde O. Fisher, assistant professor of economics at Wesleyan University, has been issued by the United States Department of Labor as Bulletin No. 303. It discusses the experience of this country in the development of governmental authority in the settlement of railway disputes. The law of 1888, providing for voluntary arbitration, the Erdman Act, the Newlands Act, the Adamson law, and the Esch-Cummins law are set forth, with the reactions of the different factions, that is, the unions, the railroad operators, and the public.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Annual convention June 19-21, Haddon Hall, Atlantic City, N. J.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next annual convention June 14 to 21, Atlantic City, N. J.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION V.—PURCHASE AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Meeting June 19, 20 and 21, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, June 26-30, 1922, Chalfonte-Haddon Hall, Atlantic City, N. J.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition postponed until October 2-7, 1922, Detroit, Mich.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meeting second Thursday in January, March, May, September and November, Hotel Iroquois, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central building, Cincinnati, Ohio. Regular meetings second Tuesday, February, May, September and November.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Convention Hotel Sherman, Chicago, August 15, 16 and 17.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 5-8, 1922.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday each month except June, July, August and September, Copley Plaza Hotel.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings third Friday of each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternate.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in each month, except June, July and August, at Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday of each month, except June, July and August.

Austria Builds 300 Locomotives in 1921

The locomotive works of Austria were well employed during 1921, chiefly on foreign orders, according to Commerce Reports. About 300 locomotives were built and delivered, as against 211 and 144 in the two preceding years. In order to keep up with the increased demand the leading firms have undertaken large additions and improvements of their plants. On account of the light demand within the country the railway car establishments were obliged to undertake foreign orders. They also had a great deal of repair work to do for foreign countries. It is difficult to obtain orders for cars from the Succession States because they are trying to get their cars from Germany by way of reparations payments.

Locomotive Orders

THE PATAGONIAN RAILWAY has ordered 25 Mikado type locomotives from the Baldwin Locomotive Works.

THE ATLANTIC COAST LINE has ordered 80 Pacific type locomotives from the Baldwin Locomotive Works.

THE ERIE has ordered 15 Decapod locomotives from the United States Government. These are part of the locomotives originally built for the Russian government.

THE NEW YORK, NEW HAVEN & HARTFORD, reported in the May issue of the *Railway Mechanical Engineer* as having ordered 15, 0-8-0 type locomotives from the American Locomotive Company, has ordered 5 additional 0-8-0 type locomotives from the same company. These locomotives will be used in the joint service of the Central New England and the New Haven.

THE CHICAGO & NORTH WESTERN has ordered 20 Mikado type locomotives, 20 6-wheel switching locomotives and 10 Pacific type locomotives from the American Locomotive Company. The Mikado locomotives will have 27 in. by 32 in. cylinders and a total weight in working order of 304,000 lb. The switching locomotives will have 21 in. by 28 in. cylinders and a total weight in working order of 171,000 lb. The Pacific locomotives will have 25 in. by 28 in. cylinders and a total weight in working order of 269,000 lb. All these locomotives will be equipped with superheaters.

Locomotive Repairs

THE WESTERN MARYLAND is having repairs made at the shops of the Baldwin Locomotive Works to about 20 locomotives, including Pacific, Mallet and Consolidation types, and is having 8 locomotives repaired at the shops of the American Locomotive Company, Richmond, Va.

THE LEHIGH VALLEY is having repairs made and superheaters installed on 14 ten-wheel locomotives at the Dunkirk shops of the American Locomotive Company. This is the beginning of a well defined program for modernizing the small motive power on this road.

Freight Car Orders

THE CHICAGO, NORTH SHORE & MILWAUKEE has ordered 15 merchandise cars from the Cincinnati Car Company.

THE CUBAN-AMERICAN SUGAR COMPANY has ordered 50 cane cars of 15 tons' capacity from the Magor Car Company.

THE CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA has purchased 100 ballast cars from the Rodger Ballast Car Company.

THE NORTHERN PACIFIC will purchase 1,000 box cars, 250 convertible work and coal cars, 250 steel coal cars and 250 stock cars.

THE CHICAGO & NORTH WESTERN, in addition to its recent car order, has purchased 20 box cars and 10 flat cars from the Western Steel Car & Foundry Company.

THE CHESAPEAKE & OHIO has ordered 1,500 hopper cars from the Newport News Shipbuilding & Dry Dock Company, and 1,500 gondola cars from the Pullman Company.

THE AMERICAN REFRIGERATOR TRANSIT COMPANY, noted in the Railway Age of April 8 as inquiring for 2,000 refrigerator cars, has ordered this equipment from the American Car & Foundry Company.

THE MISSOURI, KANSAS & TEXAS has ordered 300 flat cars of 40 tons capacity from the General American Car Company and 1,500 box cars from the American Car & Foundry Company. The same company also ordered 500 automobile cars from the Mt. Vernon Car Manufacturing Company.

THE NEW YORK CENTRAL will have 1,000 refrigerator cars of 35 tons' capacity for its own lines and 500 for the Michigan Central built in the shops of the Merchants Dispatch at East Rochester, N. Y. Mention was made in the May issue of the *Railway Mechanical Engineer* that these cars would be built by the Merchants Despatch.

THE SOUTHERN RAILWAY has divided an order for 6,140 box cars as follows: American Car & Foundry Company, 3,000, with an option on 1,000 cars additional; Mt. Vernon Car Manufacturing Company, 1,390; Standard Steel Car Company, 1,000, and 500 40-ton automobile box cars from the Standard Steel Car Company and 250 caboose cars from the Lenoir Car Works.

Freight Car Repairs

THE ST. LOUIS-SAN FRANCISCO will repair 1,800 or more freight cars in its own shops.

THE EMPIRE REFINERIES, INC., have awarded a contract to the North American Car Company for repairs to 600 steel tank cars

THE CHESAPEAKE & OHIO has given a contract to the Newport News Shipbuilding & Dry Dock Company for repairing 100 freight cars.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has ordered 200 sets of underframes and superstructures from the Pullman Company.

THE ELGIN, JOLIET & EASTERN has ordered 200 car bodies for 50-ton structural steel side dump cars and 300 car underframes from the J. W. Heggie Company, Joliet, Ill.

THE BANGOR & AROOSTOOK is rebuilding 250 freight cars in its shops at Derby, Me., which work was authorized last year, and is contemplating the rebuilding of 250 more. The company has recently purchased two Russel snow-plows.

Passenger Car Orders

THE CHESAPEAKE & OHIO has ordered 22 undivided coaches, 8 divided coaches, 8 combination passenger and baggage, 5 express with automobile doors and 20 straight express cars, from the Pressed Steel Car Company.

THE SOUTHERN RAILWAY has ordered 75 cars from the Pullman Company and 25 cars from the American Car & Foundry Company. These include 40 steel passenger coaches, 10 steel combination passenger and baggage cars and 25 steel baggage express cars to be built by the Pullman Company and 25 steel postal cars to be built by the American Car & Foundry Company.

Machinery and Tools

THE CUBA RAILROAD has ordered a number of heavy machine tools for use in its new shops at Camaguey, Cuba.

THE WESTERN MARYLAND has placed orders for the following machines: 36 in. and 48 in. lathes; 6 in. pipe threading machine; 2 in. bolt cutting machine; two 28 in. vertical drilling machines; 5 ft. radial drill; 84 in. boring and turning mill; 36 in. and 42 in. planers; 6 in. car hack saw; 300-ton wheel press and a bushing press.

Shop Construction

ATCHISON, TOPEKA & SANTA FE.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for additions to its machine shop at Topeka, Kan., to cost approximately $60,000.

CISCO & NORTHEASTERN.—This company has awarded a contract to J. H. Latson, Cisco, Tex., for the construction of a 40-ft. by 200-ft. brick locomotive repair shop in that city, to cost $12,500.

GREAT NORTHERN.—This road has awarded a contract to the National Boiler Washing Company, Chicago, for the construction of a hot water washout and refill system at Wenatchee, Wash., and to the F. W. Miller Heating Company, Chicago, for a similar system at Minneapolis Junction, Minn.

PERSONAL MENTION

GENERAL

H. E. SMITH has been appointed engineer of tests of the New York Central Lines with headquarters at New York.

J. MCKENZIE has been appointed general car inspector of the Pere Marquette with headquarters at Grand Rapids, Mich., succeeding W. F. Crowder, who has been promoted to shop efficiency engineer.

ROBERT QUAYLE, general superintendent of motive power and machinery of the Chicago & North Western, has retired after 54 years of service with this road. Mr. Quayle was born on the Isle of Man November 23, 1853, and entered railway service in 1868, as a machinist apprentice on the Chicago & North Western in its Chicago Avenue shops. In 1872 he was transferred to the shops at Fortieth street, Chicago, where in October, 1877, he was promoted to assistant foreman. Three years later he was made foreman of the car and machine shops. On June 15, 1885, he was promoted to master mechanic with jurisdiction over all lines in Iowa. On April 1, 1891, he was promoted to general master mechanic of the Milwaukee, Lake Shore & Western, where he remained until December 1, 1894, when, following the absorption of this road by the Chicago & North Western, he was promoted to superintendent of motive power and machinery, with headquarters at Chicago. On November 1, 1913, he was promoted to general superintendent, motive power and car department and on March 1, 1920, he became general superintendent, motive power and machinery.

Robert Quayle

ELRED BYRON HALL has been promoted to superintendent of motive power and machinery of the Chicago & North Western, succeeding H. T. Bentley, promoted. Mr. Hall was born at Parkersburg, Iowa, December 31, 1870, and entered railway service on September 23, 1889, as an engine caretaker for the Chicago & North Western at Eagle Grove, Iowa. He served in that capacity and later as a machinist helper until 1892, when he became a shopman at Hawarden, Iowa, where he served until 1898, when he became a locomotive fireman. After nine years' service as a locomotive fireman and three years' service as a locomotive engineman on the Sioux City and the Northern Iowa divisions he became road foreman of engines of the Sioux City division, in which capacity he continued until 1912, when he was promoted to master mechanic of the Wisconsin division, being transferred to the Sioux City and Northern Iowa divisions in 1914. In 1917 he became assistant to the general superintendent of motive power at Chicago, the duties of which office had to do chiefly with labor matters. In 1917 he was appointed assistant superintendent of the Wisconsin division, with headquarters at Milwaukee, Wis., and in 1919 he was promoted to assistant superintendent of motive power at Chicago, with jurisdiction over lines west of the Missouri river. A year later he was promoted to principal assistant superintendent of motive power and machinery with jurisdiction over the entire system.

E. B. Hall

HARRY T. BENTLEY has been promoted to general superintendent of motive power and machinery of the Chicago & North Western, succeeding Robert Quayle, retired. Mr. Bentley was born in London, England, on June 4, 1862, and was educated at Dulwich College in that country. He entered railway service in 1877 as a machinist apprentice on the London & Northwestern (England). After 10 years' service he became foreman of the enginehouse of the same road at Chester, England, where he remained until 1892, when he came to America and entered the service of the Chicago & North Western as a machinist in its Chicago shops. Shortly thereafter he was promoted to foreman in the shops at Boone, Iowa, and in 1895 he was transferred to Belle Plaine, Iowa, where he remained until 1898 when he became general foreman of the shops at Clinton, Iowa. Seven months later he was promoted to master mechanic of the Madison division and on December 30, 1899, he was transferred to the Iowa division. On August 31, 1902, he was promoted to assistant superintendent of motive power and machinery, with headquarters at Chicago and on October 31, 1913, he was promoted to superintendent of motive power and machinery, with the same headquarters, in which capacity he served continuously to the time of his promotion to general superintendent, except for the period from February 2, 1918, to June 19, 1918, when he was assistant director of transportation of the United States Railroad Administration, in charge of mechanical matters, with headquarters at Washington, D. C., in which capacity he served as chairman of the committee organized to prepare plans and specifications for standard locomotives and cars. Mr. Bentley was president of the American Railway Master Mechanics' Association in 1911-1912; and president of the International Railway Fuel Association the following year.

H. T. Bentley

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

JAMES E. GOODWIN has returned to the Northern Pacific as master mechanic at Duluth, Minn., after a five months' leave of absence and John A. Marshall, acting master mechanic, has been appointed road foreman of engines at Duluth.

PURCHASING AND STORES

R. M. NELSON has been appointed purchasing agent of the Chesapeake & Ohio. Mr. Nelson was born in Hanover county, Virginia, on November 6, 1873, and was educated at McGuire's University School, Richmond, Va. After having completed schooling in 1890, he entered the service of the Chesapeake & Ohio (then the Newport News & Mississippi Valley) as a clerk in the store department at Lexington, Ky. During the following year, he served in the same capacity in the freight office and then in the auditor's office at Lexington. In 1892 he went to Ashland, Ky., as a clerk in the freight office and during the same year was transferred to Lexington in the same capacity. In 1901 he was promoted to traveling auditor and, in 1904, was appointed chief clerk in the freight office at Newport News, Va. In January, 1912, he became chief clerk to the purchasing agent at Richmond, Va., and in January, 1916, was promoted to assistant purchasing agent. He was appointed assistant to the director of purchases and stores in April, 1921, and was serving in that position at the time of his recent promotion.

A. W. Hix has been appointed assistant to the director of purchases of the Chesapeake & Ohio. Mr. Hix was born at Bramwell, W. Va., on December 10, 1892, and was educated in the public schools and at Massey's Business College at Richmond, Va. On November 24, 1908, he entered the service of the Chesapeake & Ohio in the office of the storekeeper at Richmond. Two years later he was transferred to the purchasing department as stenographer to the assistant chief clerk. From that time on he worked in various positions including those of file clerk, invoice clerk, trace clerk, tabulation clerk and order clerk, in which position he was serving at the time of his recent promotion as noted above.

A. W. Hix

OBITUARY

ALFRED W. GIBBS, chief mechanical engineer of the Pennsylvania, with headquarters at Philadelphia, died suddenly from heart failure on May 19 at his home in Wayne, Pa. Mr. Gibbs was born at Fort Fillmore, N. M., on October 27, 1856. He attended Rutgers College Grammar School, New Brunswick, N. J., and Rutgers College (the latter institution in 1873 and 1874) and then entered Stevens Institute of Technology, Hoboken, N. J., from which institution he was graduated in 1878. In March of the following year Mr. Gibbs entered the service of the Pennsylvania as a special apprentice in the Altoona shops and continued as such until June 1, 1881, when he became a draughtsman. Four months later he left the Pennsylvania to become a draughtsman for the Richmond & Danville (now the Southern). In 1886 he was promoted to master mechanic and served in that position on several divisions until 1890, when he was appointed superintendent of motive power of the Central of Georgia. Two years later that position was abolished and he returned to Richmond & Danville as master mechanic. In July, 1893, Mr. Gibbs returned to the Pennsylvania as assistant mechanical engineer and served in that position until September, 1902, when he was appointed superintendent of motive power of the Philadelphia, Wilmington & Baltimore (a subsidiary of the Pennsylvania). On January 1, 1903, he was promoted to general superintendent of motive power of the Pennsylvania Railroad and on July 1, 1911, was appointed to the newly created position of chief mechanical engineer, in which capacity he was serving at the time of his death. Mr. Gibbs was one of the managers of the Franklin Institute, Philadelphia. He served for many years as chairman of the Committee on Tank Cars of the Mechanical Division of the American Railway Association. He was a member of the advisory committee of the Locomotive Cyclopedia for each edition of that volume excepting that of 1912 and at the time of his death was chairman of this committee. Mr. Gibbs played a prominent part in the mechanical design of the electric locomotives built for the Pennsylvania Railroad's electrification at New York.

A. W. Gibbs

SUPPLY TRADE NOTES

The Foamite Firefoam Company has removed its office from 200 Fifth avenue to 151 Fifth avenue, New York City.

C. K. Lassiter, vice-president in charge of manufacturing of the American Locomotive Company, New York, has resigned.

The Sharon Pressed Steel Company has removed its office from 66 Broadway to its new warehouse at 47 West Broadway, New York City.

The Chicago-Cleveland Car Roofing Company has moved its general offices from the Railway Exchange building, Chicago, to the Kimball building.

Leslie G. Lamborn has been appointed manager of the Sheet Metal and Wire Works division of the Parker Rust-Proof Company, Detroit, Mich.

The Davis Brake Beam Company, Johnstown, Pa., has removed its sales office from the Frick Annex to 1619 Oliver building, Pittsburgh, Pa.

The McClellan Products Company, Chicago, has recently been organized to handle the McClellan refrigerating machine for installation on railroad cars.

W. E. Mathews has joined the sales organization of the Lima Locomotive Works, Inc., Lima, Ohio. He will devote his entire time to the sale of Shay geared locomotives.

The Metal & Thermit Corporation, New York, has removed its Pittsburgh branch office from 1427 Western avenue to 801-807 Hillsboro street, Corliss Station, Pittsburgh, Pa.

Howard Yeomans has been elected president of the Bishop & Babcock Company, Cleveland, Ohio, succeeding E. S. Griffiths, who has resigned due to ill health. F. R. Pleasanton has been elected vice-president and general manager.

C. E. Allen, manager of the central station division of the Westinghouse Electric & Manufacturing Company, with headquarters at Chicago, has been promoted to manager of the St. Louis, Mo., office, with headquarters in the latter city.

J. Martin Duncan, follow-up engineer of the Detroit Steel Casting Company, Detroit, Mich., has been promoted to general sales manager and E. R. Young has been appointed follow-up engineer to succeed Mr. Duncan.

W. H. Saunders, district sales representative of the National Cast Iron Pipe Company, with headquarters at Dallas, Tex., has been transferred to Kansas City, Mo. He will be succeeded at Dallas by B. L. Hendershot.

Louis F. Vonier, formerly sales engineer of the Federal Bridge & Structural Company, with headquarters at Waukesha, Wis., has been appointed district representative of the Lyon Metallic Manufacturing Company, Aurora, Ill., with headquarters at Milwaukee, Wis.

E. A. Langenbach has been elected president of the Alloy Steel Corporation, Canton, Ohio, succeeding H. R. Jones, resigned; Mr. Langenbach also has been re-elected chairman of the board of directors. John McConnel, who recently returned to the company, and Elton Hoyt, of Pickands, Mather & Co., Cleveland, Ohio, have been elected directors, succeeding E. L. Hang and J. A. Buell, while George H. Clark has been elected vice-president and general manager, and C. W. Kreig, vice-president, secretary and treasurer, succeeding Mr. Hang as treasurer. Mr. McConnel has been elected vice-president in charge of operations.

The Bucyrus Company, South Milwaukee, Wis., has under way extensive enlargements to its plants at South Milwaukee and at Evansville, Ind. In the South Milwaukee plant, where all the larger machinery is built, a new gray iron foundry is now under construction, 276 ft. in length. The old gray iron foundry is being converted into a cleaning room with annealing ovens, sand blast rooms and a welding room. A large addition is also being made to the steel foundry molding floor, and an electric furnace is being installed. At the Evansville plant, which specializes in the manufacture of small revolving shovels, the machine and erecting shops are being considerably enlarged.

I. L. AuWerter, sales representative of the Carnegie Steel Company in the Michigan territory, has been appointed Michigan district sales manager of the Apollo Steel Company, with headquarters at Detroit, Mich.

E. P. Waller, assistant manager of the railway department of the General Electric Company, Schenectady, N. Y., has been appointed manager of the railway department. J. G. Barry, who has heretofore held the positions of general sales manager of the company and manager of the railway department, will in the future devote his entire time and attention to the work of the sales managership. Mr. Waller was born in Martinsville, Va., and was graduated from the Virginia Polytechnic Institute in the class of 1900. Following his graduation he entered the testing department of the General Electric Company at its Schenectady Works. After two years in that department he joined the staff of its publication bureau and later served as associate editor of the General Electric Review. In the fall of 1903 Mr. Waller took up commercial railway work under Mr. Barry and in 1912 he was appointed assistant manager of the railway department, which position he held at the time of his recent appointment as manager of that department.

E. P. Waller

W. T. Tyler has been elected director, vice-president and general manager of the National Safety Appliance Company, San Francisco, with temporary headquarters in the Peoples Gas building, Chicago. Mr. Tyler was born in Janesville, Wis., on July 20, 1870. He entered railway service in June, 1883, as a messenger on the Wisconsin Central and was later an operator and dispatcher on the same road. In 1889 he was employed as a brakeman on the Milwaukee, Lake Shore & Western, now a part of the Chicago & North Western. From that time until 1891 he was a brakeman and conductor on the Northern Pacific, and from 1891 to 1900 he was consecutively, yardmaster, trainmaster and a superintendent of the Great Northern. He was appointed a superintendent of the St. Louis, Iron Mountain & Southern in 1900, and was promoted to general superintendent the following year. He was later successively general superintendent and general manager of the St. Louis-San Francisco. In 1915 he became a superintendent of the Northern Pacific, with headquarters at Pasco, Wash., and on February 1, 1917, was appointed general manager of the St. Louis-Southwestern. On May 15, 1917, he was elected first vice-president of this road, and on November 1, 1917, he resigned to become assistant to the vice-president in charge of operation of the Northern Pacific. On January 22, 1918, Mr. Tyler was appointed assistant to the director of the Division of Operation, with headquarters at Washington, D. C., and he was appointed senior assistant director on July 1, 1918. He was appointed director of the division of operation on January 15, 1919, in which capacity he served until March 1, 1920, when he became vice-president in charge of operation of the Northern Pacific. He later resigned and, as mentioned above, has now entered the railway supply field.

W. T. Tyler

S. F. Bowser, founder and president of S. F. Bowser & Co., Fort Wayne, Ind., has retired from the presidency of the company to become chairman of the board. Mr. Bowser served for 37 years as the head of the business which was started by him in March, 1885. A change of organization was effected so that he could transfer to others some of the responsibilities he had carried for such a long time and he was made chairman of the board of directors and S. B. Bechtel was elected president. The company has its home plant at Fort Wayne, Ind., a Canadian plant at Toronto, Ont. and a third plant at Milwaukee, with tank assembly plants at Albany, N. Y., and Sydney, Australia. The company makes oil and gasoline tanks and pumps and other allied products, including a high grade system of oil filtration. S. B. Bechtel, the new president, entered the employ of the company in 1899, in the collection department; two years later he was appointed assistant superintendent of salesmen and, the following year, manager of the mail order sales and advertising departments. In 1906 he was appointed assistant to the general manager and subsequently served consecutively as secretary, assistant general manager, general manager and, since 1920, as vice-president and general manager until his election as president.

S. F. Bowser

S. B. Bechtel

A. W. Preikschat has been appointed western manager of the car hardware department of the National Lock Washer Company, Chicago. After graduating from high school, Mr. Preikschat received his technical training at Armour Institute of Technology. He then served with the Pullman Company for four years, in the drafting and template departments, and then for five years as assistant to the engineer of tests in charge of physical inspecting and testing with the same company. He was with the Steel & Tube Company of America for one year and a half, as mechanical representative in the purchasing department and then for two years with the Liberty Steel Products Company, Inc., as assistant mechanical engineer. He later served for one year and a half with Templeton, Kenly & Company, Ltd., Chicago, as special engineer in its railway sales department.

A. W. Preikschat

Louis W. Sipley, formerly sales engineer with the Electric Storage Battery Company, Philadelphia, Pa., has been appointed sales engineer for the Safety Car Heating & Lighting Company, New York. Mr. Sipley's headquarters are in the Commercial Trust building, Philadelphia. He is a graduate of Bucknell University, holding degrees in both mechanical and electrical engineering. While with the Electric Storage Battery Company, his duties included handling the power plant and railway sales.

"No Pullman Merger," Carry Says

E. F. Carry, president of the Pullman Company, has declared that there is no foundation for various rumors connecting the Pullman Company with mergers with other concerns. "There has been no official talk or thought of buying any concern excepting our purchase of Haskell & Barker," he said. "With regard to the reported plan to segregate the operating and building functions of the company through separate organizations, I am told that such a suggestion has been made to the Pullman board of directors at least once annually for the past 10 or 12 years, and at intervals the directors have discussed it to some extent, but with no result. This year is no exception, and the matter will again be duly discussed, but whether anything will be done about it remains to be seen."

OBITUARY

William A. Greaves, a retired machine tool manufacturer, Cincinnati, Ohio, died in that city on April 18. He was the organizer of Greaves-Klusman & Company, lathe manufacturers.

Robert H. Illingworth, whose service as a director and vice-president of the Crucible Steel Company of America, prior to April 1, when he resigned, died on April 23 at his home in Newark, N. J., at the age of 61.

Laroy S. Starrett, president of the L. S. Starrett Company, Athol, Mass., died April 23, at St. Petersburg, Fla. Mr. Starrett, who was born April 25, 1836, at China, Me., was educated in country schools and worked on a farm until he reached the age of 17 when, because of his keen interest in the mechanical line, he went to Newburyport, Mass., to work in a machine shop. Work was slack there, however, and he was soon obliged to go back to farming and in 1862, or during the Civil War, he had a well-stocked dairy farm of 600 acres. Later he again abandoned farming and busied himself rainy days working out mechanical problems in a small work room in his barn. In 1866 he took out three patents and leased a shop with power in Newburyport, put in machinery and hired mechanics to manufacture Starrett's patent meat chopper, later called the American chopper. In 1868 he sold out to the Athol Machine Company, a company incorporated to manufacture his inventions, among which was a line of vises; also a shoe hook fastener. He was later forced out of the company by fellow officials who thought they could push things faster and make more money. Mr. Starrett took this set-back with patience and good nature, starting anew in the same line of activity in a little shop connected with the former Richardson machine shop and later in a part of a cotton factory. Soon afterwards he began to manufacture the Starrett line of tools and mechanical appliances which he had been for years industriously perfecting and for which he is probably best known.

L. S. Starrett

Knox Taylor, since 1910 president of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J., died at his home in High Bridge, on April 4. He was born at High Bridge on October 19, 1873, and was graduated from Princeton University with the degree of bachelor of science in 1895. In January, 1902, he entered the service of the Taylor Iron & Steel Company and worked up through various departments in the foundry and the old wheel shop until he became general manager in October, 1905. The High Bridge plant had been engaged in the production of manganese steel since 1892, under license of the Hadfield patents. In 1912 the company purchased all the interests of William Wharton, Jr., & Co., Inc., of Philadelphia, and its subsidiary, the Philadelphia Roll & Machine Company. The Wharton Company had originated the application of manganese steel in track work in co-operation with the old Taylor Iron & Steel Company, and the new combination became known as the Taylor-Wharton Iron & Steel Company. In 1913 the company also bought out the interests of the Tioga Iron & Steel Company, Philadelphia. During the war, Mr. Taylor, in additio nto the work of his company's own contracts for gun forgings, helped supply railway track material for the American Expeditionary Forces. Mr. Taylor was a vice-president of the Railway Business Association and a member of many clubs.

TRADE PUBLICATIONS

Pneumatic Drills.—Pigmy pneumatic drills for light work are described and illustrated in a four-page leaflet recently issued by the Independent Pneumatic Tool Co., Chicago, Ill.

Reducing Valves.—A 28-page reference book of rules, tables, curves, data and formulas to determine the correct size and capacities of reducing valves; also for determining the capacity and flow of steam in pipes of different diameters and different losses in pressure, has recently been issued by the Atlas Valve Company, Newark, N. J.

Aluminum Roofing.—Aluminum roofing is the title of a 15-page booklet issued by the American Aluminum Architecture Company, Aurora, Ill., on aluminum as a roofing material. This booklet discusses the adaptability of aluminum for building purposes, and describes in detail the Ridgdown aluminum shingles and other roofing products which this company manufactures.

Evaporators for Boiler Feed Water.—The application of evaporators to the purification of boiler feed water by distillation is covered in a general and non-technical manner in bulletin No. 360 recently issued by the Griscom-Russell Company, New York. This booklet is so written that the application of Reilly self-scaling evaporators to the power plant may be readily understood by executives.

Spindle Specifications.—"The Spindle Book" is the title of an unusual 59-page booklet recently issued by the Jacobs Manufacturing Company, Hartford, Conn. Spindle specifications of various machine tools for which either taper shank drills, taps or drill chucks may be used, have been compiled and printed in this booklet under the names of the respective manufacturers of the products listed.

Hand Cut Files.—Murcott & Campbell, Brooklyn, N. Y., has just issued a finely illustrated catalogue of 43, 9 in. by 12 in. pages showing the various kinds and sizes of hand cut files made by this company. Enameled paper is used in the catalogue and the illustrations are so clear cut as to give an accurate idea of the actual appearance of the files. Forty-three different kinds of files are illustrated and the catalogue will be of great assistance in showing file users just which type of file will best serve their individual needs. Price lists of files and rasps are included.

Welding Rods and Electrodes.—A 40-page handbook known as Catalogue No. 500 has recently been issued by the Page Steel & Wire Company, Bridgeport, Conn., which gives a variety of information concerning Page-Armco welding rods and electrodes for oxy-acetylene and electric welding. The catalogue is well illustrated and in addition to the welding rod data, it contains a fund of miscellaneous information useful to the welder concerning the metallurgy of iron and steel, amount of welding material required per lineal foot of weld, definitions of electrical units, mensuration factors, wire gage table, etc.